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ANATOMY

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# PHYSIOLOGY AND ANATOMY

WITH CHAPTERS ON COMMON DISEASES  
AND ACCIDENTS  
AND A LIST OF COMMON MEDICAL TERMS

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## PREFACE

It has been brought to the writer's notice during several years of medico-legal work that those—solicitors, insurance officials, and others—who have to deal with claims for personal injuries and diseases, have little to assist them in the medical part of their work, and that the information they need is scattered and difficult of reference. The author has, therefore, made an attempt to include in one volume such information as his experience of the difficulties of those doing this work has shown him they need. He has also borne in mind the requirements of those entering for examinations involving an elementary knowledge of medical subjects, such as those of the Chartered Insurance Institute.

To include even the essentials only within the necessarily limited space has proved no easy task, but the author hopes that sufficient has been included to enable his readers to obtain a clear idea of any of the ordinary medical problems with which they may be faced.

The book has been arranged in two sections. The first deals with Anatomy and Physiology in as elementary a way as is possible, and the second gives a brief account of common diseases and accidents with the cause, main symptoms and complications, and duration of disability in each.

The author has adopted the unusual course of arranging the first section in such a way that the account of the physiology of each system of the body follows immediately that dealing with the anatomy of the same part. This has been done in order to enable the reader to have the two aspects of the same subject close at hand.

The second section of the book has been arranged as far as possible to include diseases affecting the different systems of the body in separate chapters, and in each chapter the diseases have been arranged in alphabetical order. It is hoped that this will render reference as easy as possible. With the same object in view a very full index has been added.

In order to make the book more complete, and, as the author hopes, more useful, a glossary has been added. This glossary

contains, in addition to definitions of medical terms, a large number of references to diseases not included in the body of the book. In some cases reference is made to the same subject in both glossary and text of the book. Such references are indicated by the letter "G" in the index.

One of the most difficult problems arising in the study of a fresh science is its nomenclature. Unfortunately, Anatomy teems with technical terms, names and phrases, and this is one of the greatest difficulties with which the student has to contend. An attempt has been made in writing this book to use as few technical terms as possible, but it must be recognized that there are no two words to describe the great majority of the anatomical points, and it has been necessary, therefore, in most cases to use technical terms. Technical terms are usually accurate and lay terms are frequently inaccurate and clumsy. The reader, however, has been assisted as far as possible over these fences by occasional interpolated explanatory notes, by a short explanation of the technical terms in the introduction to each chapter where it has been deemed advisable, and by as complete a glossary as is possible in a work of this kind.

The ideal method of learning Anatomy is, of course, by dissection. Such a method is not available for the general reader, and although the dissection of dead animals is of some assistance, the introduction of any instruction with this object has been intentionally omitted, as the numbers of readers likely to avail themselves of this is very small, and there are many inexpensive works dealing with the subject.

The illustrations have been made as numerous and as clear as possible. Some have been specially drawn and others have been borrowed and adapted from leading anatomical textbooks, and the author takes this opportunity of expressing his sincere thanks to Messrs Longman Green & Co., publishers of *Gray's Anatomy* and *Quain's Anatomy*, and to the Oxford Medical Publications, Oxford University Press, publishers of *Cunningham's Practical Anatomy*, for their kind permission to make use of illustrations taken from these works.

In conclusion, the author hopes that the book may be of real use to members of the Legal and Insurance Professions for whom it has been more particularly written.

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# INTRODUCTION

"KNOW Thyself" is an injunction as important to-day as it was when first spoken. Human anatomy is one of the sciences whose aim it is to elucidate the problems of the structure of the body, and physiology, its sister science, deals with the problems of the functions or uses of the various organs and parts of the body.

In the first section of this book an attempt has been made to review as clearly as possible the main facts of both these sciences. Just as it is impossible to understand how a machine works unless one knows how it is made, so is it impossible to appreciate the functions of any part of the body and their meaning unless one has also a knowledge of its structure.

Conversely the bare facts of Anatomical Science are meaningless unless their application or use is understood.

For this reason the chapters in the first section of this book have been arranged generally in pairs, an anatomical one followed by one dealing with the physiology of the same part or system of the body.

The human body is the most elaborate chemical and physical laboratory, and the actions and reactions taking place in it are very imperfectly understood, but it is only by a study of the physics and chemistry of the body tissues that any intelligible interpretation can be reached. Whatever views we may hold as to the nature of the origin of life, its effects must be studied by chemical and physical means, and the more deeply these sciences are applied the more complicated does the working of the body appear to become.

It is a study which can never be exhausted, but the simpler facts and theories are not the less interesting because they are elementary. Although these facts and theories must be docketed and arranged, the reader is warned that this is done merely for convenience, and he must not lose sight of the essential unity and interdependence of all the parts of the body and their functions.

As the basis of the body is the living cell, it is essential at the outset that a clear idea of this should be obtained.

## Cells.

All the tissues of the body are composed of living cells or of the products of living cells

A living cell in its simplest form consists of a minute mass of a semifluid, gelatinous substance called *protoplasm*. Protoplasm is of an extremely complex chemical structure and is very unstable,

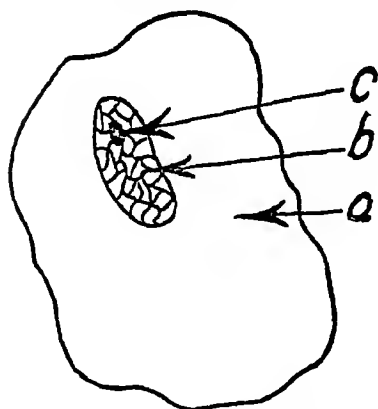


FIG 1 —A SIMPLE CELL

a = Body (of protoplasm)  
b = Nucleus  
c = Nucleolus

readily breaking up into simpler chemical substances, which are non-living. In other words, the complexity of the chemical composition of protoplasm is associated with the phenomena characteristic of living substances, and if this complexity is interfered with these phenomena cease and the substance therefore "dies"

Every living cell is further characterized by the presence of a nucleus of specialized protoplasm, arranged

usually in threads of a complicated pattern, these are brought to light by their property of being affected by certain chemical stains, which do not affect ordinary protoplasm in the same way. In many cells there is also a delicate membrane surrounding the whole cell.

It is impossible to describe in detail all the properties of living cells, and in fact no completely satisfactory definition of the term "living cell" has yet been proposed, but there are certain essential characteristics of such a cell which are clear and well defined. These are (i) Power of growth, (ii) Power of independent movement, (iii) Power of reproduction.

(i) **GROWTH IN SIZE** Growth in size of a cell is effected by absorption into the protoplasm of the necessary elements (carbon, hydrogen, oxygen, nitrogen, sulphur, and phosphorus), from simpler chemical compounds. The cell then re-arranges these elements in the appropriate proportions and they become part of the living protoplasm. In unicellular organisms, i.e. organisms consisting of only one cell, these elements are obtained from the fluid in which such organisms live. Any residue that must of necessity arise,

when such an organism takes into itself the minute particles of matter and extracts from them what it needs, is passed out again from the cell. This in a simple cell takes place all over the surface of the cell. This is the simplest manifestation in nature of the three vital processes, ingestion (taking the food), digestion (extraction of the necessary constituents for the nutrition of the cell), and excretion.

(ii) **POWER OF INDEPENDENT MOVEMENT** Inorganic or non-living material has no power of independent movement. It is completely subject to external forces. It has no "will of its own." Even the simplest unicellular living organism has some power of independent movement, and if such an organism is watched under a microscope, it can be seen to alter slowly in shape, extruding processes of protoplasm here and retracting them there, and this property is associated with the expenditure of a definite though minute amount of energy. This energy the protoplasm obtains from the oxidation of the material it absorbs. The oxygen necessary for this process is derived from the water or air contained in the water in which it lives. One of the chief products of such oxidation is carbon dioxide, and this is the simplest manifestation of respiration found in the animal kingdom, but it is in essentials the same as that occurring in the human body.

(iii) **POWER OF REPRODUCTION** When a certain stage of growth is reached, the cell can no longer continue to add to its bulk, and it then divides into two, usually symmetrical, daughter cells.

The nucleus first divides and the two halves separate and carry with them their part of the maternal protoplasm. The mother cell thus ceases to exist, and two daughter cells take her place. This is the simplest form of reproduction, and when the division is complete, each new cell starts to grow and so the cycle is completed.

### **Warmth and Oxidation.**

From this very brief account the essential principles on which the activities of living tissue are based can be appreciated in an elementary way. It is evident that living cells must be placed in an appropriate environment, in order that the above complicated process may be carried out. Apart from the necessity for (i) fluid, (ii) oxygen, (iii) assimilable forms of carbon, hydrogen, nitrogen,



etc., another condition of primary importance is warmth. The vital cell processes cannot be carried out in the absence of warmth. Warmth is required for all these processes, and can either be provided from without or, if the supply from this source is not adequate, be augmented by the heat associated with the chemical reactions taking place in the cell itself.

Oxidation is really a process of combustion and heat is liberated in the process. If, therefore, sufficient material is present for oxidation sufficient heat for the cell's needs will be formed. Heat is used by the body in building up protoplasm, is liberated during muscular action, and is lost by radiation from the surface of the body. All this heat must be supplied and made good, and in addition sufficient heat must be produced to maintain the body temperature at such a level as will enable the tissues to carry on their several functions. This heat is all derived from the oxidation of material taken into the body and a balance of heat loss and heat production is maintained so accurately that the temperature of the normal human body ( $98.4^{\circ}$  Fahrenheit) varies only a degree or two, week in week out.

The essentials of the physiology of the human body are the same as those of a unicellular organism. Material to replace old cells by building new ones, energy for muscular action, and fluid in which the cells of the body are bathed are produced from the food we eat, and absorb from our stomach and intestines. Heat is obtained by the oxidation of these food substances, and the oxygen necessary for this is supplied to the blood, and so conveyed to every cell, through the lungs from the air during respiration. The residue of food unabsorbed is passed out of the body as excreta. The broken down products of the activities of the cells are carried away by the blood and some (carbon dioxide) is excreted by the lungs (Expiration) and some (nitrogenous products) are excreted dissolved in water by the kidneys.

### Glands.

Certain cells of the body form, during their activity, special substances which are necessary for the body generally, and have special characteristic properties. Such cells are arranged in groups, and the substance secreted (Secretion) may be conveyed either

directly to the blood by the lymph channels (see *Lymphatic System*, Chapter XVIII) or to other parts of the body by means of small tubes (ducts) All glands are of such a character, i e are composed of such specialized cells These glands and their functions are described in the body of the book.

### Specialized Cells.

Other cells are specialized to form certain structures such as nails, hair, teeth or bone How these cells become endowed with these special properties is unknown, but it is interesting to note that it occasionally happens in the development of the individual that some of these cells may be displaced and form tumours, in which bone, hair, etc , may be found

Microscopically most of these cells can be distinguished from each other, but it is not proposed to describe appearances as seen under the microscope, as no practical purpose is likely to be served by this to readers

These are the broad principles of physiology in their barest form,

It is unfortunate that in many ways the skeleton is not so interesting as other parts of anatomy, and that the reader must at once be introduced to a rather formidable technical nomenclature, but as the whole structure of the body is based on the skeleton, it is from this point that anatomy is usually approached



# PHYSIOLOGY AND ANATOMY

## SECTION I PHYSIOLOGY AND ANATOMY

### CHAPTER I

#### ANATOMY OF THE SKELETON

THE skeleton which forms the solid basis on which the whole body is built consists of a large number of bones, all of which have the same general structure

#### Structure of Bone.

Every bone is made up of two essential parts, one of which, the *organic*, is living, and the other, the *inorganic*, is not living. The former consists of living cells which by their growth and multiplication cause the bone to grow in size. They also have the property of extracting salts from the blood and depositing these salts as a hard matrix round them. These salts, consisting chiefly of the salts of calcium, form the inorganic part of the bone and are responsible for its hardness. The organic part gives rise to the elasticity, and it is on the happy proportion between these two elements that the hardness, strength, and resiliency of the bone depend.

#### Section of Bone.

If a bone, whether it be a long bone, as in the limbs, or a flat bone, as in the skull, be cut across, it will be found to consist of two well defined parts: (1) an outer *compact* layer which is very hard, and (2) an inner, *cancellous* or *medullary* part, which is soft and is popularly called the "marrow" of the bone.

The *Compact bone* consists almost entirely of inorganic material but has also layers of bone cells and small canals microscopic in

size (called *Haversian canals*) in which the bone cells live. Larger canals also pass through the bone to convey blood-vessels.

The *Cancellous bone* consists almost entirely of the blood-vessels and bone cells forming the organic part of the bone.

Covering the bone is a membrane, the *Periosteum*, which is

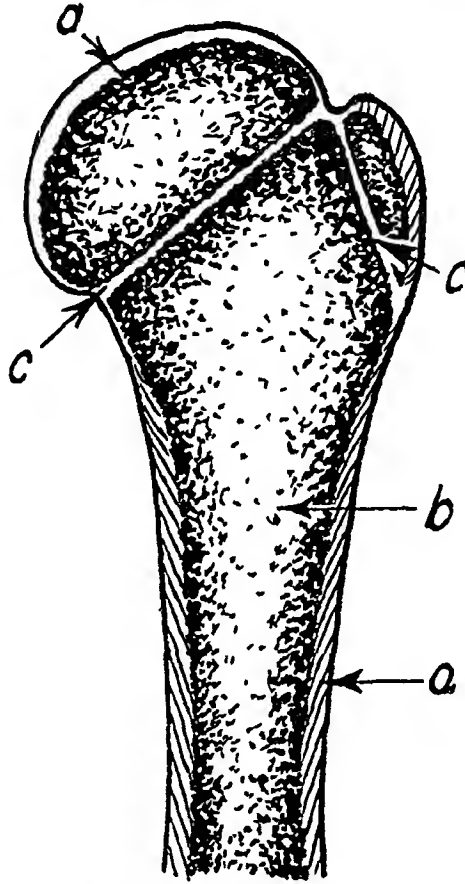


FIG 2 —SECTION OF END OF A LONG BONE

a = Compact bone

b = Medullary or cancellous bone

c = Epiphyseal cartilage

d = Articular cartilage

vascular and supplies nourishment to the outer part of the underlying bone.

### Growth of Bone.

This is in two directions, circumferential and longitudinal. Circumferential growth is effected by the multiplication of the bone cells and deposit round them of inorganic salts.

Growth in length is effected at the ends of the bones by the

activity of a layer of cartilage which passes across the bone within a short distance of its extremity, thus separating the main *Shaft* from the two extremities or *Epiphyses*

This cartilage is called the *Epiphyseal Cartilage* and disappears when the adult stage of growth is reached. At that time the whole bone becomes ossified and the epiphyses are said to be united to the shafts

This description applies to all the long bones of the body, but the skull bones have no epiphyseal cartilage and instead of being formed from cartilage are formed from a fibrous membrane in which bone cells appear and grow centrifugally so as to form a gradually enlarging plate of bone. Such bones are called *Membrane Bones*

### **Difference between Adults' and Children's Bones.**

Owing to the necessity for rapid growth in the case of a child, it will be readily understood that the bones in childhood must contain a relatively larger proportion of the living or organic part and, therefore, that these bones are softer and bend more easily than adult bones. A child's bone will bend simply by the weight of the body, as is frequently seen when the child is encouraged to stand and walk before the proper age. This condition is most marked, of course, in cases of rickets, which is a disease of nutrition causing a diminution of the normal deposit of calcium salts. A normally developed child's bone, however, will bend if any excessive strain is thrown upon it. If a still greater strain is encountered the bone may break, and if it does so it frequently breaks like a green stick, i.e. half-way across and then longitudinally. This is known as a "green-stick" fracture.

Adult bones, however, are more resistant and break only if very considerable violence is used. Moreover, when they do break the fracture is usually complete, in any case, in a normal adult bone the fracture is never green-stick.

As old age comes on, the tendency of the whole body is to become devitalized and to lose its elasticity, and this tendency is reflected in the bones by a diminution in the proportion of organic material and consequent increase in brittleness. An old bone will sometimes break with very little more than a severe jar.

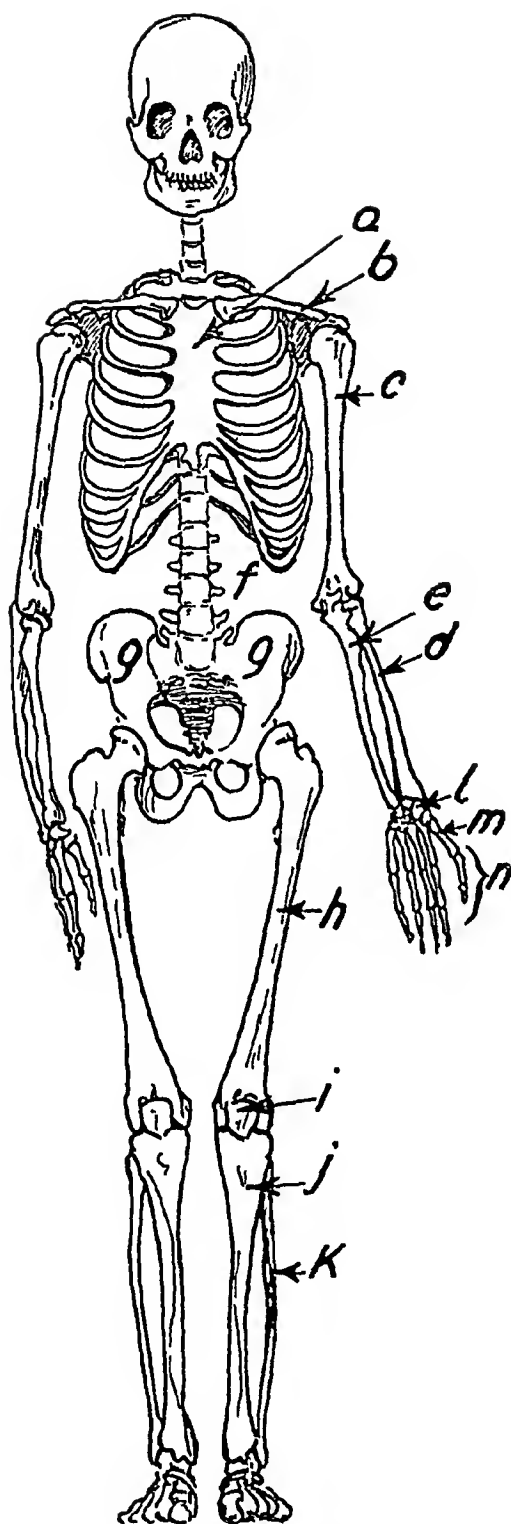


FIG 3 —SKELETON

- |  |                             |
|--|-----------------------------|
| <i>a</i> = Sternum to which are attached the ribs forming the thorax | <i>h</i> = Femur            |
| <i>b</i> = Clavicle  | <i>i</i> = Patella          |
| <i>c</i> = Humerus   | <i>j</i> = Tibia            |
| <i>d</i> = Radius  | <i>k</i> = Fibula           |
| <i>e</i> = Ulna  | <i>l</i> = Carpal bones     |
| <i>f</i> = Lumbar vertebrae  | <i>m</i> = Metacarpal bones |
| <i>gg</i> = Iliac bone, forming the pelvis                           | <i>n</i> = Phalanges        |

## DESCRIPTION OF THE SKELETON

The skeleton may be divided into the following parts—

- |                 |                   |
|-----------------|-------------------|
| 1 Skull         | 4 Shoulder girdle |
| 2 Spinal column | 5 Thorax          |
| 3 Limbs         | 6 Pelvic girdle.  |

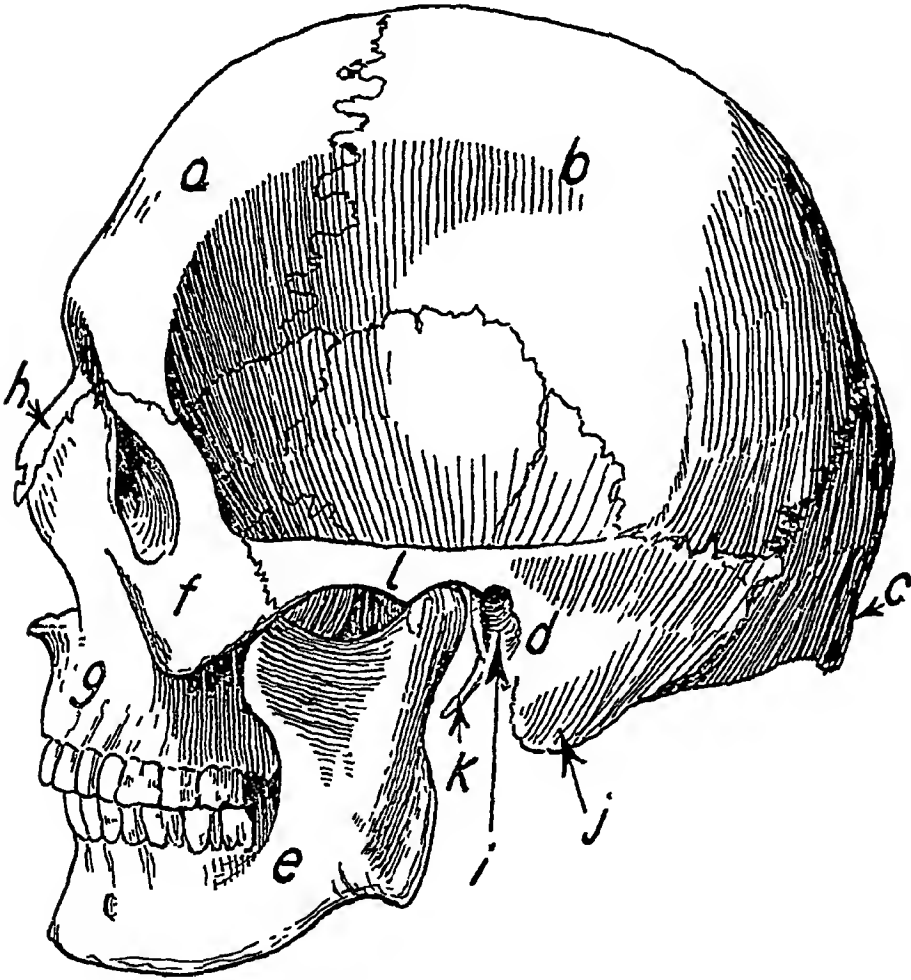


FIG 4—SKULL (SIDE VIEW)

- |                      |  |
|----------------------|--|
| a = Frontal bone     | g = Superior maxilla                   |
| b = Parietal bone    | h = Nasal bone                         |
| c = Occipital bone   | i = External auditory meatus           |
| d = Temporal bone    | j = Mastoid process of temporal bone   |
| e = Inferior maxilla | k = Styloid process of temporal bone   |
| f = Malar bone       | l = Zygomatic process of temporal bone |

### Skull.

For descriptive purposes the skull may be divided into two parts .  
(1) Cranium, and (2) Facial bones

1 CRANIUM This is the main hollow part of the skull containing



the brain, and is divided anatomically into six regions corresponding in names to those of the main bones forming the skull

(a) *Frontal* The frontal region is the fore part of the skull formed by the frontal bone. This forms the whole of the forehead from and including the upper margins of the orbits (eye cavities) to a short distance behind the margin of the hair

The frontal bone is therefore almost vertical in position, but from its lower border it sends back two plates of bone, each forming the upper part of the orbit and therefore called the *Orbital Plate*. It is this part of the frontal bone that separates the forepart of the brain from the eyes

There are two small cavities in the frontal bone, called the *Frontal Sinuses* one situated over the inner end of the upper margin of each orbit and communicating with the corresponding nasal cavity. The frontal bone articulates with the *Parietal* and *Temporal* bones

(b) *Parietal* The parietal region is the region corresponding with the parietal bones. There is a right and left parietal bone which articulate with each other in the middle line of the roof of the skull. They extend roughly half-way down each side, articulating in front with the posterior margin of the frontal bone and below with the temporal bones

(c) *Temporal* The temporal regions are the lower parts of the sides of the skull above and in front of the ears

The temporal bones corresponding with this region are very complicated in shape, but each consists briefly of four parts, viz (1) a flat shell-shaped portion in front forming part of the side of the skull and articulating with the frontal bone in front and the parietal bone above. This portion is called the *Squamous* portion. (2) A solid pyramidal shaped mass of bone which projects forwards and inwards to form part of the floor of the skull. This is the *Petrous* portion of the temporal bone. (3) A nipple-shaped projection of bone which can be felt with its point downwards lying immediately behind the ear. This is the *Mastoid* process.

The bony orifice of the ear (the *External Auditory Meatus*) lies immediately in front of this process. (4) The *Zygomatic* process (or *Zygoma*) which is a process of bone arising just in front of the external auditory meatus. It tapers as it passes forwards, and is

attached in front to the *Malar Bone*. On the under surface of this process where it arises from the main part of the bone is situated the articular surface for the lower jaw.

Attention is drawn particularly to parts (2) and (3) of the temporal bone as they are of the greatest importance in connection with the ear. The petrous portion contains the inner parts of the ear, namely, the essential parts for hearing called the *Middle* and *Internal Ear*, and the mastoid process contains large spaces within, which communicate with the middle ear, and any disease of the one may, and frequently does, involve both. As these two parts are separated from the brain by only a very thin layer of bone, the significance of their liability to infection from the ear, and so to convey this infection to the brain, is clear.

(d) *Occipital*. This is the back part of the skull and is formed by the occipital bone which articulates above and in front with the parietal bones on each side, and below, at the side, with the back part of the temporal bones.

The occipital bone is almost hemispherical in shape and its lower part projects forwards towards the middle of the base of the skull, and is perforated by a large hole, the *Foramen Magnum*, through which the stem of the spinal cord passes from the brain to the spinal column.

(e) *The Base*. The base of the skull is formed by the parts of the frontal, temporal, and occipital bones mentioned, and the irregular gap left is filled in by a bone of extremely complicated shape called the *Sphenoid*.

2 **FACIAL BONES**. The facial bones need not be described in detail but their names and positions should be remembered.

1 *Nasal Bones*. These are two small oblong-shaped bones, one on each side, joined in the middle line as the sides of a roof, to form the bridge of the nose.

2 *Superior Maxilla* (Upper Jaw). The upper jaw is formed by the fusion of two bones, viz. the right and left superior maxilla. The upper part of each superior maxilla helps in the formation of the *orbit*, the lower and inner wall of which are formed chiefly by the upper surface of this bone. Towards the middle of the face the superior maxilla on each side articulates with the nasal bones and so completes the bony wall of the nose. Posteriorly the

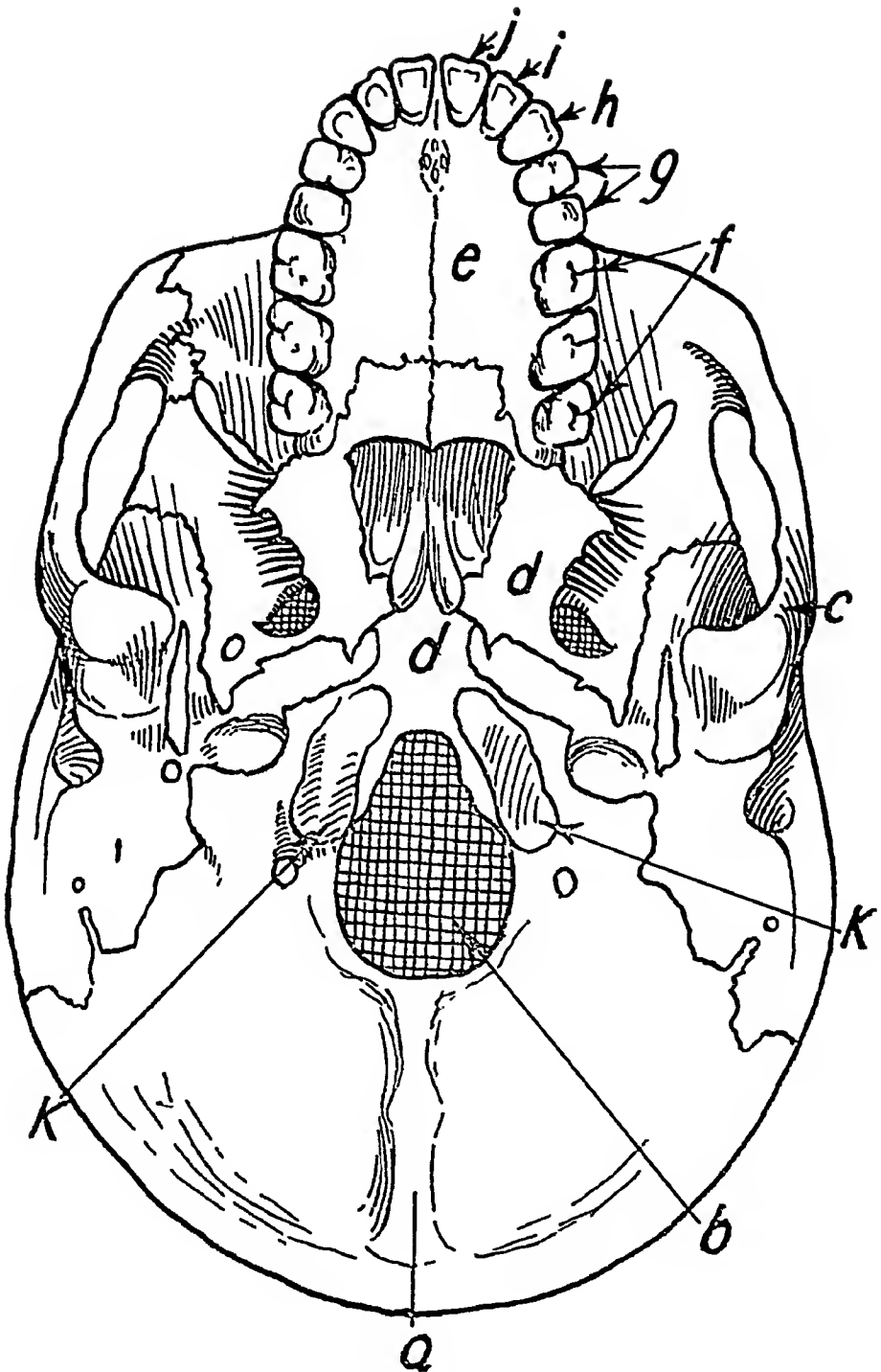


FIG 5—BASE OF THE SKULL

a = Occipital bone  
b = Foramen magnum for passage of spinal cord  
c = Zygomatic process of temporal bone  
d = Basis of the sphenoid bone  
e = Hard palate  
f = Mandible  
g = Premolar teeth  
h = Canine teeth  
i = Lateral incisor teeth  
j = Central incisor teeth  
k = Articular surfaces forming joint with the atlas vertebra

Q = Occipital bone  
a = Foramen magnum for passage of spinal cord  
c = Zygomatic process of temporal bone  
d = Basis of the sphenoid bone  
e = Hard palate  
f = Mandible  
g = Premolar teeth  
h = Canine teeth  
i = Lateral incisor teeth  
j = Central incisor teeth  
k = Articular surfaces forming joint with the atlas vertebra

superior maxilla articulates with the base of the skull. The under surface of the floor of each superior maxilla forms the anterior three-quarters of the bony part of the roof of the mouth (Hard

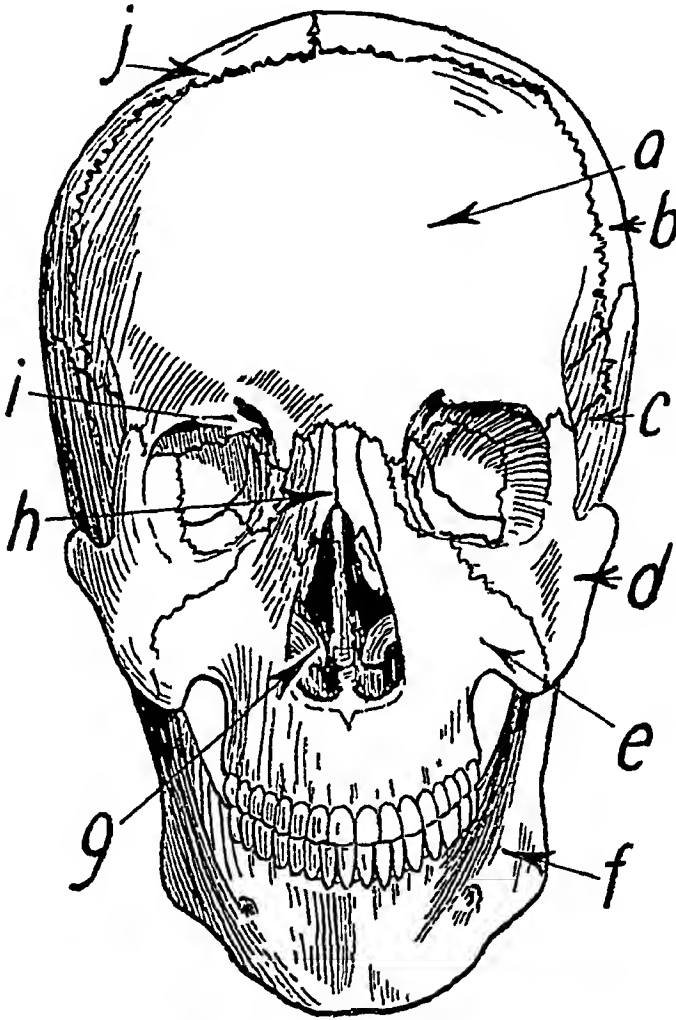


FIG 6 —SKULL (FRONT VIEW)

- |                             |                               |
|-----------------------------|-------------------------------|
| a = Frontal bone            | f = Inferior maxillary bone   |
| b = Parietal bone           | g = Turbinate bone (inferior) |
| c = Temporal bone           | h = Nasal bone                |
| d = Malar bone              | i = Supra-orbital ridge       |
| e = Superior maxillary bone | j = Fronto parietal suture    |

Palate) The teeth are attached to the under aspect of the inferior border of the superior maxilla, the portion of bone to which they are attached being sometimes called the *Alveolar Margin* of the jaw.

Each superior maxilla is hollow and contains a cavity called the *Antrum of Highmore*. This cavity communicates by apertures

with the nasal cavity and the roots of certain of the teeth are in very close proximity to the floor of the cavity

3 *Malar Bones* (Cheek bones) These are two small bones, one on each side of the face, attached to the upper jaws and forming the bony prominence of the cheek. The upper border of the malar bones forms part of the lower and outer margin of the orbit.

4 *Inferior Maxilla* (Lower Jaw) The lower jaw is formed by the fusion of two halves, the right and left inferior maxilla. The fusion of these bones in the middle line forms the prominence of the chin (*Symphysis Menti*). Each inferior maxilla is usually described as being formed by a horizontal portion (the body of the bone) and an ascending portion or ascending *Ramus*. The junction of these forms the angle of the jaw. The teeth are attached to the upper edge of the body of the bone. The ascending ramus branches into two parts, an anterior *Coronoid Process* (flattened from side to side) to which some of the muscles of mastication are attached, and a posterior, more vertical portion, called the *Condyle* of the bone which articulates just in front of the ear with the temporal bone.

There are various other small bones entering into the formation of the nose, palate, orbit, and base of the skull, which need not be described, but the following should be remembered—

*Palate Bone* This is an extremely irregularly-shaped bone which has a flat, oblong-shaped process extending across the back of the hard palate, and which forms the posterior quarter of this part of the roof of the mouth.

*Ethmoid Bone* A spongy mass of bone assisting in the formation of the upper and back part of the nose, and also entering into the formation of part of the base of the skull.

*Turbinate Bones* These are very thin scroll-like bones attached to the outer wall of the nose on each side and projecting into the nasal cavities. There are three in number on each side, the superior, middle, and inferior.

**TEETH** *General Structure.* Each tooth is composed of a crown and a root. The former only is visible normally, and the root is firmly attached to the corresponding socket in the alveolar margin of the jaw. In section the crown of the tooth consists of three parts, viz (1) a central pulp in which the nerve endings are situated, and surrounding this is (2) a hard canalized substance

called *Dentine*, and outside this is (3) a hard enamel. The root consists of (1) and (2) but instead of being covered with enamel is surrounded by a bony "cement" This is separated from the bony socket of the tooth in the jaw by a layer of periosteum. The nerve and blood supply of each tooth enters at the lower end, or apex, of each root.

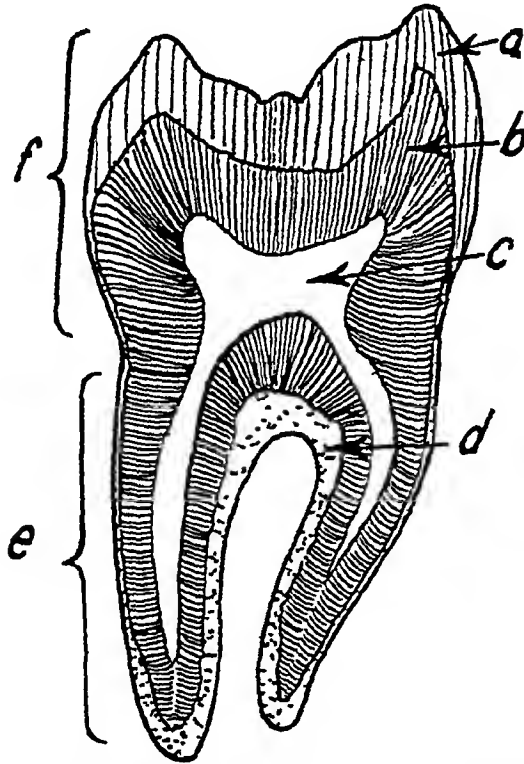


FIG 7—DIAGRAM SHOWING STRUCTURE OF A TOOTH

a = Enamel	d = Cement
b = Dentine	e = Roots
c = Pulp cavity	f = Crown

*First and Second Dentition* The first teeth to appear are called deciduous or milk teeth, and consist of 4 incisors, 2 canines, and 4 molars in each jaw. These are arranged as follows. 2 central incisors in front, 1 lateral incisor on each side of these, 1 canine next to each lateral incisor, and then 2 molars.

The first teeth to appear are the lower central incisors at about 6-9 months of age, and the last to appear are the second molars at the end of the second year of life.

The permanent teeth are 32 in number, namely 2 central incisors, 2 lateral incisors, 2 canines, 4 bicuspids, and 6 molars in

each jaw These are arranged like the temporary teeth except that there are 2 bicusps which appear between the canines and first molars on each side and in each jaw. The permanent teeth appear between the 6th and 13th year except the third molars, which are called wisdom teeth, and which do not appear until the 17th-25th year

### Spine.

This consists of a series of separate small bones called vertebrae, (singular vertebra) The lower vertebrae are fused together to form two separate bones, (1) the large wedge-shaped *Sacrum* which forms part of the *Pelvis* and on which the weight of the whole spine and skull rests, and (2) the tail bone, or *Coccyx*, which is attached to the lower pointed end of the sacrum

The separate vertebrae, between the skull and sacrum, are divided into three main groups which are called *Cervical* (neck), *Dorsal* (back), and *Lumbar* (loin) Of these there are 7 cervical, 12 dorsal, and 5 lumbar

There is no need to describe each vertebra separately although they can be individually recognized by minor differences, but their general shape is the same and consists of (1) a solid cylindrical-shaped body, (2) an arch of bone posteriorly, (3) one lateral bony process on each side of the arch near its attachment to the body (these are called the transverse processes), (4) two articular processes which arise near the transverse processes and on which are situated the articular surfaces which unite the arches of contiguous vertebrae, and (5) a posterior projection or spinous process which projects from the back of the arch As these bones

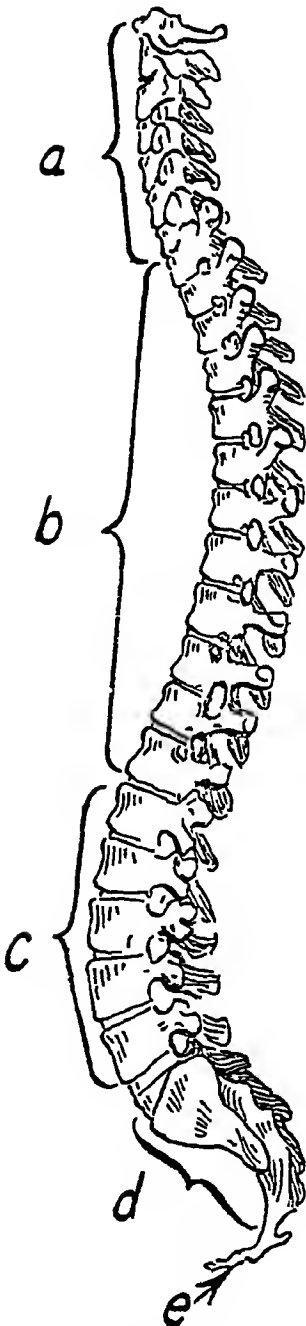


FIG 8—SPINAL COLUMN,  
SHOWING CURVES

- a = Cervical vertebrae
- b = Dorsal vertebrae
- c = Lumbar vertebrae
- d = Sacrum
- e = Coccyx

rest on each other there is, therefore, in front a solid column of bone and behind a canal formed by the succession of arches, called the *Spinal Canal*, and containing the *Spinal Cord* (nerves from the brain)

The bodies of the vertebrae are separated by cartilaginous plates or intervertebral discs, which allow a certain amount of movement

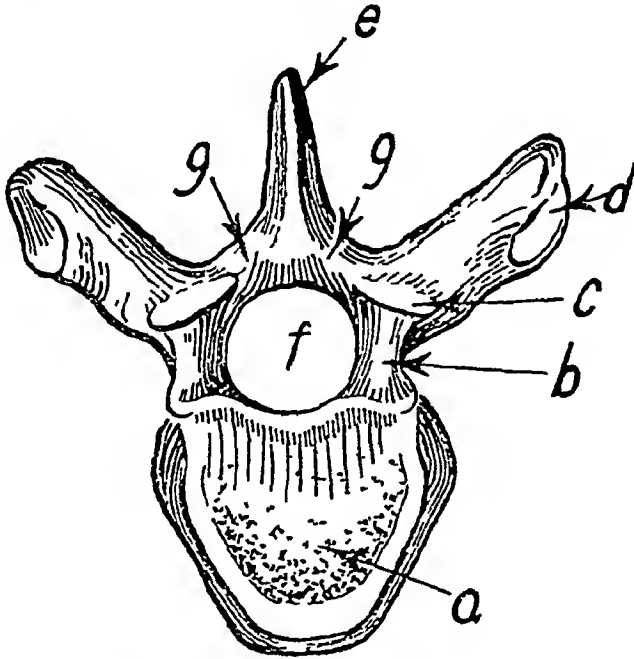


FIG 9—DORSAL VERTEBRA (SEEN FROM ABOVE)

- a = Body
- b = Pedicle
- c = Articular surface for the next vertebra
- d = Transverse process with articular surface for rib
- e = Spinous process
- f = Spinal canal
- g = Lamina

to take place between the vertebrae and at the same time act as cushions to absorb any shock directed up or down the spinal column

Although it is not proposed to give a separate description of these individual bones, one or two particular points should be remembered, namely—

(i) The topmost vertebra has no body, but consists of a ring of bone with transverse processes and a spinous process. This vertebra is called the *Atlas*.

(ii) The second vertebra is called the *Axis*, and has projecting up from its body a small process of bone which is called the *Odontoid Process*, and which passes into the front of the ring of the



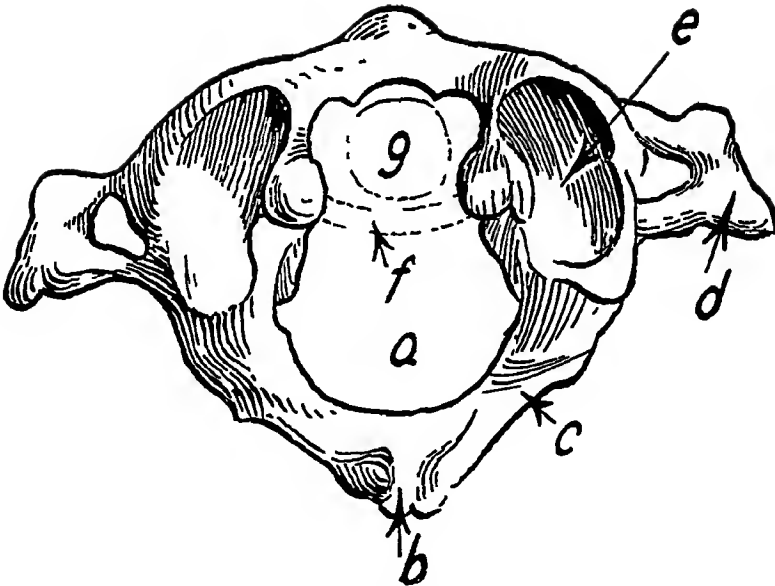


FIG 10—ATLAS VERTEBRA

- |                        |  |
|------------------------|--|
| a = Spinal canal       | e = Articular surface for skull          |
| b = Spinous process    | f = Transverse ligament                  |
| c = Lamina             | g = Position of odontoid process of axis |
| d = Transverse process |  |

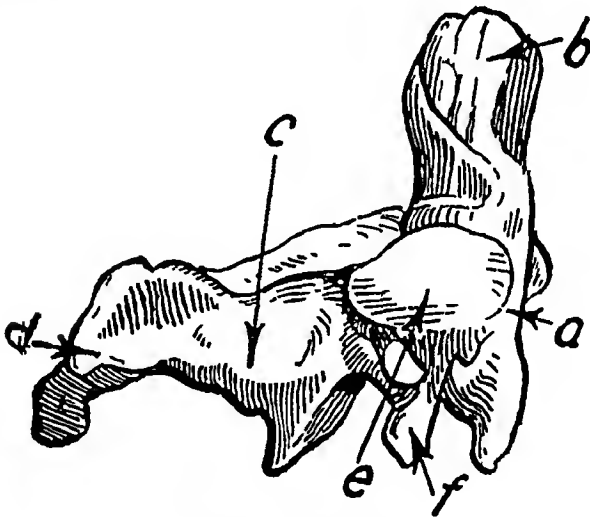


FIG 11—AXIS VERTEBRA (SIDE VIEW)

- |                      |                                 |
|----------------------|---------------------------------|
| a = Body             | d = Spinous process             |
| b = Odontoid process | e = Articular surface for atlas |
| c = Lamina           | f = Transverse process          |

atlas, being held there by ligaments. This process acts as a pivot round which the atlas and skull can rotate. It is interesting to note that in the case of a judicial hanging, death is usually due to the sudden snapping of the odontoid process which penetrates and ruptures the spinal cord at the base of the brain.

(iii) The dorsal vertebrae are characterized by having attached to them the ribs (twelve pairs)

(iv) The size of the vertebrae gradually increases from above downwards, the cervical being the smallest and the lumbar the largest.

(v) The whole spinal column is arranged with three curves, namely, a cervical curve with the convexity forwards; a dorsal curve with the convexity backwards, and a lumbar curve with the convexity forwards.

The whole column, therefore, is a very supple pillar which carries the weight of the head and body, and which, owing to its arrangement in curves and with cushions of cartilage between the vertebrae, is enabled to dissipate many jars and shocks which would otherwise (e.g. in jumping) be transmitted direct to the skull and brain.

### Sacrum.

The spinal column ends below in the sacrum, which is developmentally part of the spinal column and is formed by the fusion of five vertebrae (sacral). It is a wedge-shaped bone, with the base of the wedge situated above and the apex pointing downwards, and to this is articulated the *Coccyx*, or tail bone. The sacrum is curved with the convexity backwards, and has a canal passing through its whole length corresponding to the spinal canal formed by the other spinal vertebrae. The sacrum articulates on each side with the corresponding ilium and so forms the back of the bony pelvis. The joints so formed are called the *Sacro-iliac* joints.

### Coccyx.

This is a small bone which completes the spinal column below, and is, like the sacrum, formed by the fusion of separate bones—undeveloped vertebrae—four in number. It is slightly curved and points downwards and forwards. It is pyramidal in shape and articulates with the sacrum.

## Shoulder Girdle.

This is the name given to the bones supporting the upper limbs. These bones are the two *Clavicles* (collar bones) and *Scapulae* (shoulder blades). These bones together form a bony girdle round the upper part of the chest and to them are attached the upper limbs.

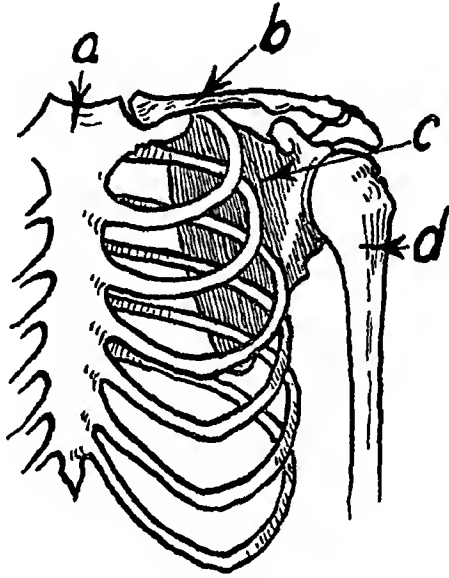


FIG 12—THE SHOULDER GIRDLE

a = Sternum  
b = Clavicle

c = Scapula  
d = Humerus

## Clavicle.

This is an S-shaped bone running across the base of the neck on both sides. Its inner end articulates with the *Sternum* (breast bone), and its outer end with the *Scapula*. It serves as a buttress and holds the shoulder joint away from the side of the chest. Its range of movement is slight, but it moves a little with all movements of the shoulder joint, pivoting on its articulation with the sternum.

## Scapula.

The scapula, or shoulder-blade, is an irregularly shaped bone, lying behind and to the outer side of the upper part of the chest wall. It is composed of three parts—

(1) A flat triangular body lying close against the chest wall, the base of the triangle being above and the apex below. The

outer and upper angle is thickened and carries on it an articular surface (the *Glenoid Cavity*), which forms with the upper end of the humerus, the shoulder joint. The three borders of the body are (a) an inner or vertebral border, (b) an outer or axillary border, (c) the superior border, above.

(ii) Arising from a line running across the upper part of the body of the bone and reaching from the vertebral border to a point just short of the glenoid cavity is a process of bone called the spine of the scapula. This stands out at right angles from the body, and is triangular in shape, the apex being at the vertebral border of the bone and the base just behind the glenoid cavity. From this end of the spine there is a curved process of bone called the *Acromion Process* which curves outwards and forwards and articulates above the shoulder joint with the outer end of the clavicle.

(iii) In addition to the above there arises from the superior border of the scapula, near the glenoid cavity, a curved process of bone called the *Coracoid Process*, which curves forwards and to which important muscles are attached.

## Thorax.

This is the upper part of the trunk containing the heart and lungs, and the bones forming it consist of the ribs, breast-bone (*Sternum*), and the dorsal vertebrae.

## Sternum

This is an elongated bone, shaped somewhat like a broad-sword, and consists of a broad upper part called the *Manubrium*, to the upper and outer corners of which the clavicles and first ribs are attached, and is continuous below with the elongated portion called the *Gladiolus*. At the junction of the manubrium and gladiolus on each side of the sternum are attached the second ribs, and the 3rd, 4th, 5th, 6th, and 7th ribs are attached to each border of the gladiolus at intervals from above downwards. At its lower extremity the gladiolus tapers to a point which is free for the attachment of muscles, and is called the *Ensiform Process*.

## Ribs.

These are twelve in number and are divided into two groups,

the upper seven attached behind to the spine and in front to the sternum, a small piece of cartilage, called the *Costal Cartilage*, connecting the anterior end of each rib with that bone. The lower five ribs are called *False Ribs*, the upper three of which are attached at their anterior ends to the costal cartilage of the rib immediately above them and, therefore, only indirectly to the sternum. The lower two ribs are the floating ribs, and are not attached anteriorly, and these ribs are much shorter than the others and do not form part of the thoracic wall.

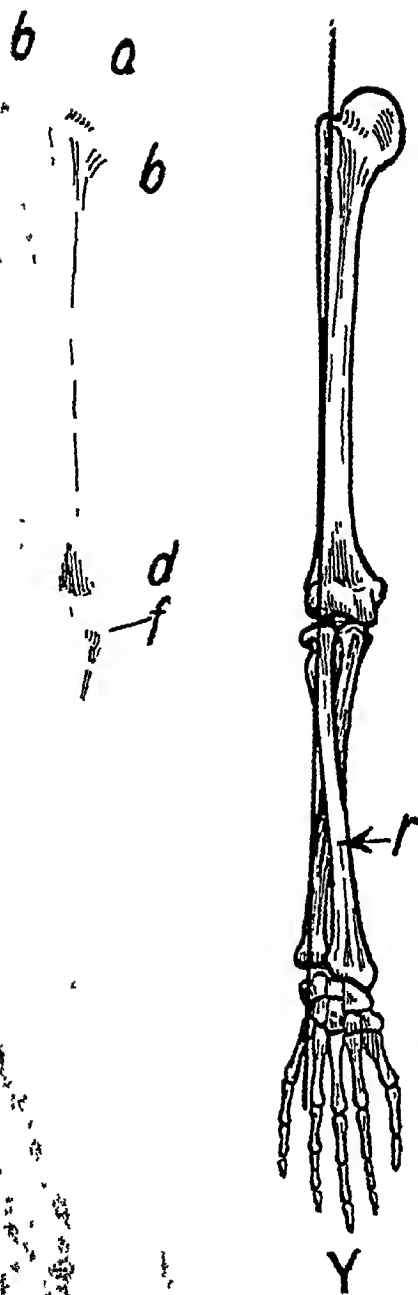
The remaining ten ribs being joined behind to the spinal column, and in front, either directly or indirectly, to the sternum, form a complete skeletal protection for the vital organs contained within the thorax.

### Arm.

**Humerus.** The humerus is the bone of the upper arm, and is divided into an upper extremity or *Head*, which is globular in shape, and articulates with the glenoid cavity of the scapula to form the shoulder joint; a shaft; and a lower end which is flattened anteriorly and expanded laterally and which has an articular surface which, with the upper end of the bones of the forearm, forms the elbow joint. The inner and outer ends of the expanded lower part of the humerus, which can be felt prominently beneath the skin, are called the inner and outer condyles of the humerus. (See Fig. 11.)

The head of the bone is not at a slight angle with the shaft, so that the upper articular surface looks upwards and inwards, and is joined to the shaft of the bone by a slightly narrower portion called the *Neck*. Where the neck joins with the shaft two processes of bone are developed, one on the outer side called the *Greater Tuberosity*, and one in front called the *Lesser Tuberosity*. Two bones enter into the formation of the forearm, viz.: (i) Ulna and (ii) Radius.

(i) *The Ulna* lies to the inner side of the forearm and articulates above with the lower end of the humerus. The articulation is a *hinge*, and the articular surface of the ulna is like a deep groove running across the front of the upper end of the bone, and the groove is deepened by two processes of bone arising from it, one in



# Y BONES OF THE ARM AND HAND

in changing from position of X  
by the thick straight line, the  
ed

- g = Carpal bones
- ' = Metacarpal bones
- = Phalanges
- ^ Styloid process of radius
- ead of radius
- dus

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The head of the bone is set at a slight angle with the shaft, so that the upper articular surface looks upwards and inwards, and is joined to the shaft of the bone by a slightly narrower portion called the *Neck*. Where the neck joins with the shaft two prominences of bone are developed, one on the outer side called the *Greater Tuberosity*, and one in front called the *Lesser Tuberosity*.

**FOREARM** Two bones enter into the formation of the forearm, viz (i) Ulna and (ii) Radius.

(i) *The Ulna* lies to the inner side of the forearm and articulates above with the lower end of the humerus. The articulation is a close one, and the articular surface of the ulna is like a deep groove running across the front of the upper end of the bone, and the groove is deepened by two processes of bone arising from it, one in

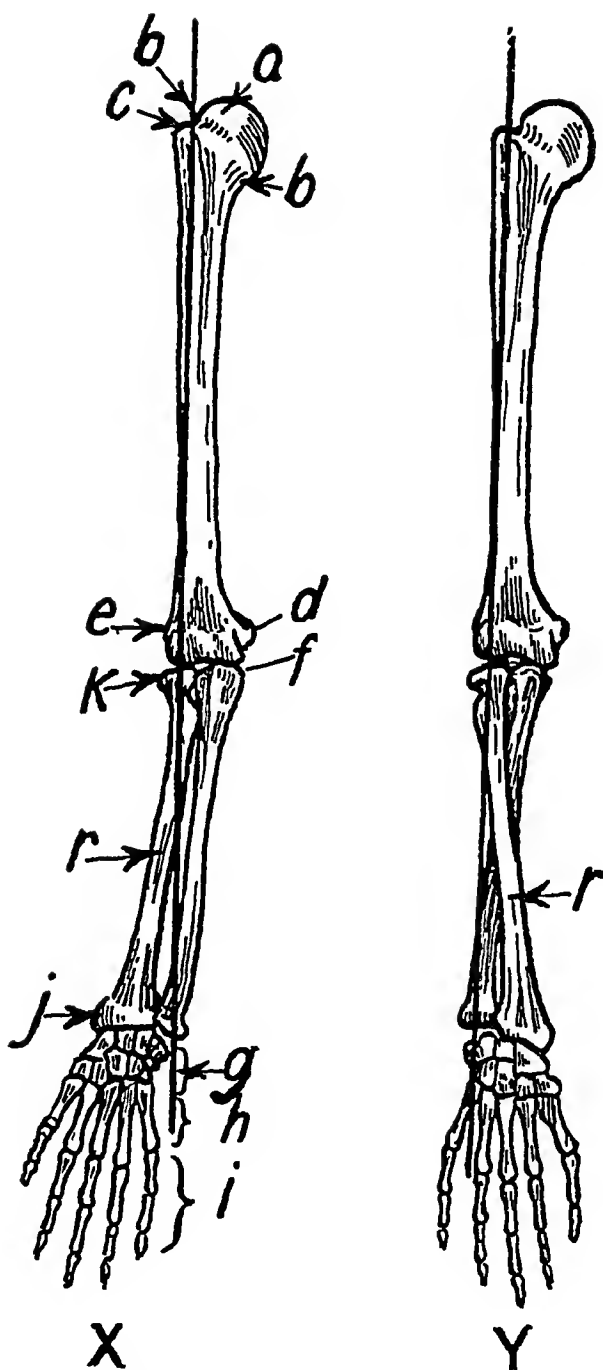


FIG 13 —DIAGRAM OF THE BONES OF THE ARM AND HAND

Illustrating the movements of the radius in changing from position of X Supination, to Y Pronation As shown by the thick straight line, the ulna has not moved

a = Head of humerus  
b = Neck of humerus  
c = Greater tuberosity of humerus  
d = Internal condyle  
e = External condyle  
f = Coronoid process of ulna

g = Carpal bones  
h = Metacarpal bones  
i = Phalanges  
j = Styloid process of radius  
k = Head of radius  
r = Radius



front and one behind, the one in front being called the *Coronoid Process* and that behind the *Olecranon* part of the latter forms the "tip" of the elbow. The shaft of the bone can be felt beneath the skin as far as the lower end towards which it tapers, but the extreme end is expanded slightly at the wrist to form the head of the bone, and towards the inner side of the head is a short-pointed process which can also be felt at the inner side of the wrist, and is called the *Styloid Process*.

(ii) *The Radius* The head of the radius is flattened and is situated at the upper end of the bone articulating in a rather loose manner with the outer half of the articular surface of the lower end of the humerus. A joint also exists between the head of the radius and the upper end of the ulna. Immediately below the head, the bone is constricted, forming the neck, and immediately below this is a projection of bone towards the inner side, called the *Bicipital Tuberosity*. To this is attached the powerful tendon of the biceps muscle. (See Fig 18)

The shaft of the bone expands as it passes downwards, and ends in the lower flattened articular surface which forms almost the entire upper part of the wrist joint. From the inner side of the articular process a triangular piece of cartilage passes across, over the head of the ulna, to be attached to the styloid process of that bone, and this cartilage completes the upper articular surface of the wrist joint. It will, therefore, be noticed that the head of the ulna does not in reality form part of the wrist joint proper, being separated from it by the cartilage just mentioned. On the inner side of the lower end of the radius, just above the border from which the triangular cartilage arises, is an articular surface which, combined with the head of the ulna, forms the lower radio-ulnar joint. (See Fig 20)

## Hand.

The skeleton of the hand is made up of a large number of small bones. These are divided into three groups—

- (i) Carpal bones
- (ii) Metacarpal bones
- (iii) Phalanges

*The Carpal Bones* are eight in number and are very irregular in

shape, and articulate closely with one another. They form the skeleton of the upper part of the palm.

Their names are the *Scaphoid*, *Semilunar* and *Cuneiform*, which, with the lower end of the radius, form the wrist joint, *Trapezium*, *Trapezoid*, *Os Magnum*, *Unciform*, *Pisiform*.

The *Metacarpals* are five in number, one corresponding to each digit. They are "long" bones, and have a base articulating with the carpus, a shaft, and a head which is situated at the lower extremity, and with the base of the corresponding phalanx, forms the knuckle joint or metacarpo-phalangeal joint of the thumb and fingers.

The *Phalanges* are fourteen in number, three for each finger and two for the thumb. Each has a base, a shaft, and a head. The base of the first phalanx of each finger articulates with the head of the corresponding metacarpal bone, and the head articulates with the base of the second phalanx. Similarly, the head of the second phalanx articulates with the base of the third phalanx in the case of the fingers.

### Lower Extremity.

**PELVIS** The pelvis is the connecting link in the skeleton between the spinal column and lower limbs. It supports the whole weight of the trunk and upper part of the body, and is, therefore, of very great strength. The bones composing it are sometimes called the pelvic girdle, corresponding to the shoulder girdle, but whereas mobility is the essential feature of the latter, stability is the characteristic of the pelvis. It is composed of three bones firmly united together but allowing a slight amount of play on each other—not enough to be consciously felt, but just sufficient to make the whole structure fall short of absolute rigidity. The bones entering into the formation of the pelvis are—

- 1 Right *Os Innominatum*
- 2 Left *Os Innominatum*
- 3 Sacrum.

The sacrum, the lower end of the spinal column, has been sufficiently described.

The *Os Innominatum* on either side is a very irregularly-shaped bone, and as it is developmentally derived from three separate

bones which subsequently become completely ossified together, it is divided anatomically into three corresponding parts called the *Ilium*, *Ischium*, and *Pubis*. No amount of verbal description can convey much idea as to the shape of this bone, and the reader is, therefore, referred to the accompanying diagram in which the three components of the bone are indicated.

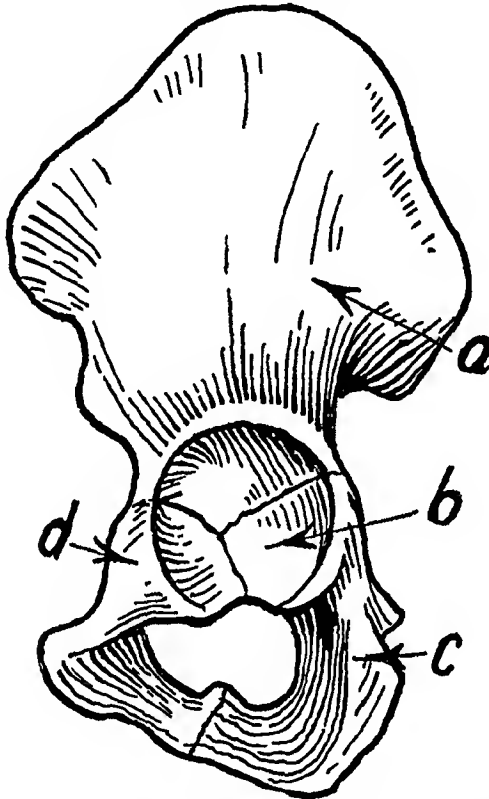


FIG 14 —TO ILLUSTRATE THE THREE DIVISIONS OF THE  
OS INNOMINATUM

a = Ilium	c = Ischium
b = Acetabular cavity	d = Pubis

It will be noticed that a central point of the bone is the articular surface for the femur. This is a cup-like cavity which, in the fresh state, is practically hemispherical, and is called the *Acetabulum*. Together with the head of the femur it forms the hip joint. Rising above the acetabulum is a flat piece of bone with a slight twist in it. This is the main part of the *Ilium*. The upper border of this is called the *Crest of the Ilium*, and can be felt subcutaneously in one's own body. The crest ends in front in a tubercle called the *Anterior Superior Spine* of the *Ilium*, and a little below is another

tubercle or spine called the *Anterior Inferior Spine*. Behind, the ilium articulates with the sacrum, forming the *Sacro-iliac Joint*.

Starting again from the acetabulum, a strong column of bone passes downwards and backwards, and then comes forwards, upwards, and inwards. This is the *Ischium* and the bony prominence caused by its curve, which can be felt in the living body, and on which the whole weight of the body rests in the sitting position, is called the *Ischial Tuberosity*.

Again, starting from the acetabulum, a more slender process of bone passes forwards and downwards to join the ascending part of the ischium. This part of the os innominatum is the pubic portion, and joins with its fellow of the opposite side to form the pubic synchondrosis or "pubes."

As will be seen from the diagram, the pubic bone is really V-shaped, and has a horizontal *Ramus* running towards the acetabulum and a descending ramus which joins the ascending ramus of the ischium.

To sum up, therefore, the pelvis is formed by—

- 1 The sacrum behind
- 2 On each side the ossa innominata (Right and Left) which articulate with the sacrum behind and with each other in front to form the pubes.

These bones, therefore, enclose a cavity called the *Pelvic Cavity*, but owing to the peculiar shape of the bones forming it, this cavity can be divided into two parts—

(i) An upper part called the *False Pelvis*, bounded behind by the upper part of the sacrum and laterally by the large expanding portion of the iliac bones, in front this portion of the pelvic cavity has no bony wall but is composed of the muscles of the lower part of the abdomen.

(ii) A lower part very much more constricted and completely surrounded by bone, called the *True Pelvis*. Its boundaries are, behind, lower part of the sacrum and coccyx, laterally the Ischial bones, and in front, the pubes.

## Lower Limb.

**FEMUR.** This is the longest and the strongest bone of the skeleton, and consists of a head, neck, shaft, and lower extremity.

The head is globular in shape and forms rather more than a hemisphere, being covered by articular cartilage. At about the mid-point of the surface is a depression to which is attached a ligament (*Ligamentum Teres*) which is attached at its other extremity to the Acetabulum.

This ligament is sufficiently long to allow free play of the head of the bone in the hip joint, but prevents excessive movement.

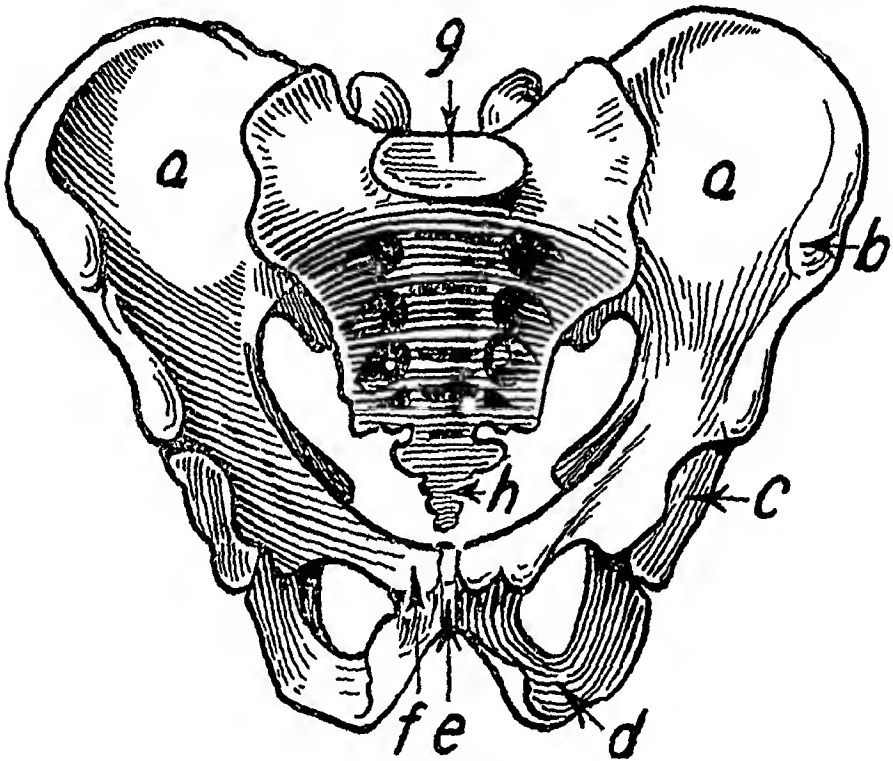


FIG 15 — PELVIS

- |                                      |   |
|--------------------------------------|---|
| a = Iliac bone (ilium)               | f = Pubic spine                                     |
| b = Anterior superior spine of ilium | g = Articular surface on sacrum for lumbar vertebra |
| c = Acetabulum                       | h = Coccyx  |
| d = Tuberosity of ischium            |   |
| e = Symphysis pubis                  |   |

In the normal upright position of the body the head of the femur points upwards, inwards, and a little forwards, and is attached to the shaft of the bone by the "neck," which is a short, stout process of bone passing downwards and outwards and forming with the shaft an angle of about  $125^{\circ}$

**TROCHANTERS** These are two stout processes of bone, a greater trochanter arising from the upper end of the shaft at its junction with the neck, and situated on the outer side of the bone, and a lesser trochanter situated at the junction of the neck and shaft on

the inner side of the latter Both these processes of bone are for the attachment of muscles

**SHAFT** This is almost cylindrical in shape, and along its posterior aspect is a rough ridge, called the *Linea Aspera*, for the attachment of muscles The whole shaft is deeply imbedded in muscles which are attached to its whole surface

Below, the shaft expands at the knee joint into two lateral masses, called the *Condyles* (internal and external), which are separated below and behind by a deep groove The condyles are covered by cartilage in front, below, and behind, and articulate with the upper surface of the tibia, so forming the knee joint (See Fig 23)

**TIBIA (OR SHIN BONE)** This is the main bone of the leg below the knee, and transmits the weight of the body to the foot It has an expanded upper extremity or head, which is flattened and has two semicircular surfaces, covered with cartilage, articulating with the condyles of the femur Between the border of each articular surface, and the edge of the corresponding condyle of the femur, lie the semilunar cartilages, which will be described with the knee joint Each half, inner and outer, of the flattened and expanded head of the tibia is called a tuberosity (inner or outer, as the case may be)

Immediately below and behind the external tuberosity is an articular surface, against which the head of the *Fibula* rests.

In front of the head of the bone and a very short distance down from the articular surface is a prominence of bone called the *Tubercle of the Tibia*, to which is attached the *Patellar Ligament*

The bone then rapidly narrows into the shaft, which is triangular in section with a sharp edge running down in front, called the *Crest*

The inner surface of the bone lies immediately beneath the skin for its whole length The outer and posterior surfaces are covered with muscles At its lower extremity the tibia again expands and forms the major portion of the upper articular surface of the ankle joint

On its inner side is a process of bone continued downwards over the inner side of the ankle joint, called the *Internal Malleolus*. The surface of this process towards the joint is covered with

cartilage, which is continuous with that covering the lower flattened surface of the tibia. The external side of the lower end of the tibia has a surface covered with cartilage for articulation with the lower end of the fibula. (See Fig 24.)

**FIBULA** The fibula is a very slender bone compared with the tibia, and is for almost its whole extent covered by muscles. It lies to the outer side of the tibia, and its upper, slightly expanded extremity called the head, lies just below the external tuberosity of the tibia, and rather posteriorly. It articulates with the under surface of this tuberosity as mentioned above.

The lower extremity articulates with the outer border of the lower expanded end of the tibia, and is then continued down over the outer aspect of the ankle joint. This process of bone is called the *External Malleolus*, and completes the articular surface which, with the astragalus bone of the foot, makes the ankle joint. (See Fig 24.)

**PATELLA, OR KNEE CAP** This is a small, almost circular, bone lying in front of the knee joint. It is covered with cartilage behind for articulation with the front of the condyles of the femur, and so enters into the formation of the knee joint. The anterior surface is subcutaneous. Above it has inserted into it the powerful anterior muscles of the thigh, and below it is attached to the tubercle of the tibia by an extremely powerful tendon, called the *Patellar Tendon*.

**FOOT** As in the case of the hand, the foot is composed of three groups of bones, called the *Tarsus*, *Metatarsus*, and *Phalanges*. There are seven tarsal bones, viz. *Os Calcis*, *Astragalus*, *Semilunar* (or *Scaphoid*), *Cuboid*, and three *Cuneiform* bones. (See Fig 25.)

These bones are arranged in an interesting way, as follows. The whole skeleton of the foot is arranged so as to form an arch which will carry the weight of the body without undue pressure on any particular bone. This arch is most marked on the inner side of the foot, and if the imprint of a wet foot is observed, it will be noticed that the inner side of the foot does not touch the ground between the heel and the ball of the great toe.

The outer border touches along its whole length. This is because the arch of the foot is most marked on the inner side. It is formed by two pillars, an anterior pillar and a posterior pillar, and at the

apex which corresponds with the ankle joint is a "keystone" bone, the astragalus

The posterior column of the arch is formed by the os calcis or, heel bone, and the anterior pillar is formed partly by the neck and head of the astragalus, and in front of this the semilunar, cuneiform, and first metatarsal bones (See Figs 25 and 26)

The arch is supported by strong ligaments which pass from the os calcis forwards to the semilunar and cuneiform bones, and in the condition known as flat foot, these ligaments give way and the arch gradually flattens out so that in a bad case the whole of the inner border of the foot rests on the ground

The only bone of the foot entering into the formation of the ankle joint is the *Astragalus*, the body of which is covered on three sides by articular cartilage and is, as it were, wedged into the hollow formed by the lower end of the tibia and the fibula

The astragalus rests on the os calcis, which is roughly an oblong-shaped bone, the posterior end of which forms the heel and the bone is placed obliquely so that in the normal position the anterior part of the bone lies above the level of the posterior part

In front the os calcis articulates with the cuboid and above with the astragalus

The astragalus is composed of a body which articulates above with the tibia and below with the os calcis, and passing forwards, is the neck (a narrow portion of the bone) terminating in a slightly larger part (the head) which articulates with the semilunar In front of the semilunar are placed the three cuneiform bones, so named from their wedge shape, being broader above than below, and to the outer side of the semilunar and cuneiform bones is the *Cuboid* This completes the tarsus

The Metatarsals are five in number, and are arranged as in the case of the hand, and to these are attached the phalanges, two in the case of the great toe and three each for the other toes

### Hyoid Bone and Cartilages of the Larynx.

**HYOID BONE** This is a horseshoe-shaped bone situated in the upper part of the neck, with its convexity forwards To it are attached the muscles forming the tongue and floor of the mouth It is placed just above the thyroid cartilage of the larynx (Adam's



Apple). It consists of a body in front quadrilateral in shape, with two processes, called the *Greater* and *Lesser Cornua*, extending backwards on each side. To the body and cornua are attached the muscles of the tongue, floor of the mouth and some of the lesser neck muscles and ligaments connecting the bone with the cartilages of the larynx, which lie beneath it

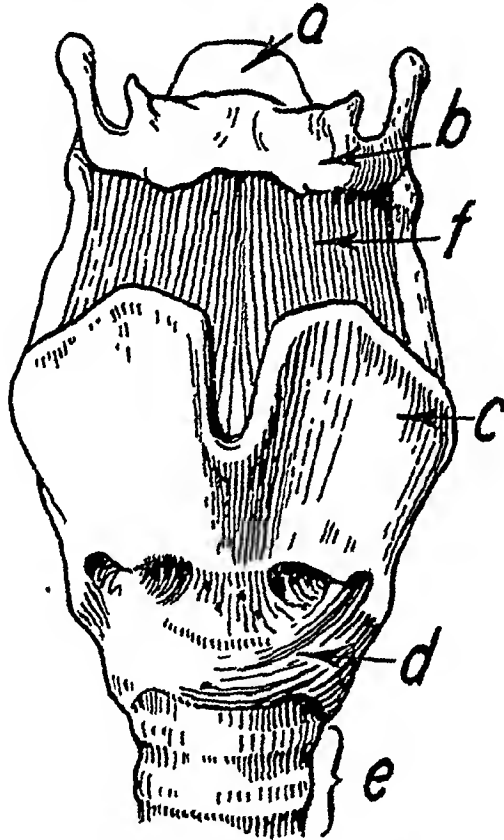


FIG 16—LARYNGEAL CARTILAGES

- |                       |                          |
|-----------------------|--------------------------|
| a = Epiglottis        | d = Cricoid cartilage    |
| b = Hyoid bone        | e = Tracheal rings       |
| c = Thyroid cartilage | f = Thyro hyoid membrane |

**LARYNGEAL CARTILAGES** There are two named cartilages forming the skeleton on which the larynx is built, viz : The *Thyroid* and *Cricoid*

The *Thyroid Cartilage* lies immediately below the hyoid bone, and it is formed by two flattened plates of cartilage, called the right and left *Ala* (wing) united in front in the middle line so as to form a V pointing forwards. The prominence of the union of the two alae is much more pronounced in the male than in the female, and is popularly called the Adam's Apple. The alae unite in front for

only about two-thirds of their length, and so a deep notch is present in the upper part of the cartilage. The alae behind are widely separated and to them are attached some of the muscles of the pharynx.

From the posterior border of each ala of the thyroid cartilage two processes extend, one upwards and one downwards. The upper one, or *Superior Cornu*, is for the attachment of ligaments, and the lower one, articulates at its end with the other important laryngeal cartilage—the *Cricoid*.

The thyroid cartilage is of the very greatest importance, as it supports the vocal cords. These are two folds of mucous membrane, supported by fibrous tissue, and having a strong fibrous strand running along their free margins. Behind they are attached to two small cartilages, supported on the cricoid cartilage, and, in front, to the back of the thyroid cartilage, where this forms the projection known as the "Adam's Apple."

The production of the voice is effected by the approximation of the cords, which are tightened by muscles and vibrate when air is expired past them.

*The Cricoid Cartilage.* This lies immediately below the thyroid cartilage, and is in shape very like a signet ring.

It is deep and broad behind, but narrows rapidly on each side and in front. The posterior portion lies to a large extent between the inferior cornua of the thyroid cartilage, and has two small articular surfaces for articulating with these cornua.

In addition are two other articular surfaces on the upper border between the alae of the thyroid cartilage for articulation with two small cartilages (the *Arytenoid Cartilages*). These cartilages are mentioned because to them are attached the vocal cords and they are, therefore, of very great importance.

*EPIGLOTTIS.* This is a leaf-shaped cartilage covered by mucous membrane. The lower end (stem of the leaf) is attached to the posterior surface of the thyroid cartilage by ligaments.

The upper end projects a little forwards behind the base of the tongue, between it and the larynx.

## CHAPTER II

### PHYSIOLOGY OF THE SKELETON

THE function of the skeleton as a whole is to provide a solid base on which the body is built. It gives rigidity and strength to the body, and affords in many parts protection to the soft parts, e g in the case of the skull, thorax, and pelvis.

The skeleton is the basis of the muscular system, and is bound together by the muscles, and is activated by them.

The bones are nourished by a double blood supply. To each bone runs a main nutrient artery which enters the bone through an aperture (the nutrient *foramen*) and ramifies in the cancellous part of the bone, and branches are also given from this to the compact layer. In addition to this, the covering of the bone, a fibrous sheet, called the Periosteum, is also well supplied with blood vessels, and the outer layers of the growing bone almost certainly receive their blood supply from this source. The periosteal blood supply to the adult bone is more doubtful, and authorities are not yet in agreement over this point.

*Blood Formation* This is one of the unexpected functions of the bones. The *Medulla*, or marrow, of the long bones is extremely vascular, and is formed partly of cells whose function it is to reproduce the red cells of the blood.

### FUNCTIONS OF THE DIFFERENT PARTS OF THE SKELETON

#### Skull.

The function of the skull is almost entirely one of protection for the enclosed brain. The facial bones have other functions, e g the turbinate bones whose shape enables a large area of mucous membrane (which covers them) to be exposed to the air, and so to aid in warming the air on its way to the lungs.

The hard palate and accessory nasal sinuses contained in the *Superior Maxillae* act as "sounding boxes" and give resonance to the voice.

## Spinal Column.

The function of this is to support the whole body and to give support and attachment through the pelvis and shoulder girdle to the limbs

The spinal column supports the head, and, in order to supply the necessary strength to support the body and mobility to allow free play to the body movements, has to combine rigidity with suppleness. This effect is obtained by the construction of the spinal column in a series of segments (vertebrae) which are closely interlocked by their articulations and ligaments, and yet allow considerable mobility, this being obtained by the sum of the slight individual movements of each vertebra on its adjoining one. It will also be remembered that the spinal column is curved in the cervical, dorsal, and lumbar regions, with the convexity forwards in the cervical and lumbar regions and backwards in the dorsal region.

In this way, as was pointed out in the preceding chapter, jars which would otherwise be transmitted to the head and so to the brain are, as it were, smothered.

Another most important function of the spinal column is that of protection for the spinal cord and nerves as they issue from it.

## Thorax.

The functions of the skeleton of the thorax are twofold—

- 1 To protect the enclosed heart and lungs from external violence.
- 2 To aid in respiration. The ribs are mobile and can be moved forwards and upwards or downwards and backwards, pivoting on the spine. As they move forwards and upwards they increase the cubic capacity of the thoracic cavity, and so cause expansion of the lungs and consequent inspiration of air. The reverse movement causes expiration.

## Pelvis.

The pelvis is essentially a structure of support and protection, support, as it is by the pelvis that the whole weight of the trunk above is carried, and protection, for the important organs of excretion and reproduction contained within its

cavity. The pelvis is essentially the foundation of the body, and any defect, either inherited or acquired, may be crippling in its effects

### Limbs.

The difference in function of the upper and lower limbs is shown at once by the skeleton

The function of the skeleton of the upper limb is essentially that of prehension (grasping), while that of the lower limb is equally obviously that of progression and support. The bones forming the upper and lower limbs are strikingly analogous, but their adaptation to the uses they serve is interesting. This is most noticeable in the forearm and leg (below the knee), and in the hand and foot

The forearm with the radius able to rotate round the ulna, and so allow of pronation and supination of the hand, increases enormously the range of useful activity for the hand. The thick and strong tibia, on the other hand, is obviously made as a weight carrier, and the fibula merely serves as a solid origin for muscles, it has no independent range of movement

The difference in function of the hand and foot is most markedly shown in the skeleton

The phalanges of the hand are long and slender compared with those of the foot, and are the most prominent part of the skeleton hand—clearly, the grasping function of the hand can be seen from the bones themselves

The most striking feature of the skeleton of the foot, on the other hand, is the massive tarsus, arranged in the form of a long arch, the toes (apart from the great toe) being inconspicuous. This structure clearly shows the function of the foot to be that of a support.

But the most striking difference between the skeletons of the hand and foot, and the most significant, is the opposition of the thumb bones

The metacarpal bone and phalanges of the thumb stand right out from the rest, and any movement of these bones in their natural position is towards the fingers, so as to enable the fingers and thumb to oppose each other while grasping

The great toe, however, lies parallel with the remaining toes , its only movement is that of flexion or extension , its only grip is on the ground , and its most important function is in running, when it has to do the greater part of the work of propelling the body.

## CHAPTER III

### ANATOMY OF THE JOINTS

A JOINT may be defined as the apposition of two bones or pieces of cartilage, where movement takes place

The following expressions are used to describe the various movements taking place in joints, and to assist the reader, their meanings are given below—

<i>Adduction</i>	.	Movement towards the middle line of the body.
<i>Abduction</i>	.	Movement away from the middle line of the body.
<i>Flexion</i>	.	Bending
<i>Extension</i>	.	Straightening.
<i>Inversion</i>		Applied to the feet, means turning the foot so that the sole looks inwards
<i>Eversion</i>	.	Applied to the feet, means turning the foot so that the sole looks outwards
<i>Pronation</i>		Applied to the wrist, means turning the hand palm downwards
<i>Supination</i>	.	Applied to the wrist, means turning the hand palm upwards
<i>Circumduction</i>		Circular movement This is applicable only to ball and socket joints, e g hip, shoulder
<i>Rotation</i>		A turning movement of one of the bones of a joint on its own axis

#### Structure of Joints.

A joint is formed of—

(i) *Articular Cartilage*. These are plates of cartilage covering the ends of the bones forming the joints They are smooth where they are in apposition in order to allow the movement to be as frictionless as possible

(ii) *Synovial Membrane* This is a membrane which lines the joint and is attached round the margin of the articular cartilages,

passing from one to the other but not covering the cartilages. The synovial membrane secretes the synovial fluid.

(iii) *Synovial Fluid* This is a thin colourless fluid which acts as a lubricant to the joint surfaces.

(iv) *Capsule* This is a tough fibrous sheet which surrounds the whole joint and is sufficiently lax to allow movement, but tight enough to prevent excessive movement. It is usually thickened in places, forming strong bands or ligaments.

(v) *Ligaments* These are strong fibrous cords (sometimes they are flattened like straps) which may be part of the capsule of the joint or may be entirely outside that structure. They are attached generally to each of the bones forming the joint near their articular ends, and form strengthening bands to support the capsule and give some additional rigidity to the joint.

Other support to the joint is given by the muscles and tendons passing over them.

### Varieties of Joints.

There are many varieties of joints, differentiated according to

(i) the nature of the tissue in apposition, i.e. whether bony or cartilaginous,

(ii) the nature and degree of movement allowed,

(iii) the shape of the articulating surfaces.

Only a few of the varieties need be mentioned here. The commonest are—

1 **IMMOBILE JOINTS** (Synarthrosis)—where the articulating surfaces are closely connected and are attached by fibrous tissue with practically no free movement. The main variety of this is the *Suture*, found only in the articulation of the skull bones, which are joined together by a very intricate line of indentations and tooth-like projections. There are other varieties described, but they need not be mentioned here.

2 **MIXED JOINTS** (Amphiarthrosis) The participating surfaces in these joints are usually covered with a layer of mixed cartilage and fibrous tissue and a very slight degree of “rubbing” movement is allowed. An example is the joints between the bodies of the vertebrae.

3 **MOVABLE JOINTS** (Diarthrosis), in which freedom of movement



is most marked. All the joints of the limbs are of this type, and some of the chief varieties are—

(a) *Hinge Joint* (Ginglymus), in which movement in only one plane (forward and backward) is allowed, e g elbow joint (Humero-ulnar).

(b) *Ball and Socket Joint* (Enarthrosis), in which movements in all planes are allowed, e g in the hip joint and shoulder joint

(c) *Gliding Joint* (Arthrodia), in which only gliding movements are allowed, e g the articulation of the tarsus

## DESCRIPTION OF INDIVIDUAL JOINTS

### Skull.

The bones of the face and skull are firmly united, so that in the adult no free movement of the bones on each other is possible. The junction of the bones of the skull is by means of suture (see above), and the names of the sutures are taken from the bones forming them, e g *Fronto-parietal Suture*; *Parieto-occipital Suture*, etc. There are, however, two specially named sutures, viz, the suture running along the top of the skull between the two parietal bones is called the *Sagittal Suture*, and the inverted Y-shaped suture formed by the posterior end of the sagittal suture and the two parieto-occipital sutures is called the *Lambdoid Suture*.

In the infant the skull sutures are not firmly united and considerable movement of the individual bones is allowed. This is a provision for growth, and at the same time it enables considerable moulding of the head to take place at birth, rendering this more easy and less dangerous to the child.

In the newly-born infant there are two gaps present in the bony vault of the skull covered only by membrane, which subsequently becomes ossified by the growth of the neighbouring bones. These areas are called *Fontanelles*, and are situated one at each end of the sagittal suture, the anterior fontanelle being the larger and transmitted pulsation of the brain is clearly visible there in infants. These fontanelles are closed at from 18–24 months of age.

### Vertebral Column.

There are six articular surfaces involved in the union of each

vertebra with its neighbour, three for the vertebra immediately above, and three for that immediately below. Each vertebra articulates with its neighbour by the upper and lower surfaces of its body and the upper and lower surface of each transverse process.

The joints between the bodies of the vertebrae have no synovial membrane, and the space between the bodies is filled by a soft semi-cartilaginous material, which is firmly adherent to the surfaces of both vertebral bodies. This "pad" of material is called the *Intervertebral Disc*, and acts as a cushion to modify jars between the vertebrae. The articulations between the transverse processes are true joints, and allow gliding movements to take place between the vertebrae.

The intervertebral joints are supported by ligaments of considerable strength and intricacy. Their detailed description is unnecessary, but it might be mentioned that there is one long powerful ligament running the whole length of the vertebral column, in front of the bodies of the vertebrae, and another similarly situated behind the bodies (within the spinal canal). Movements of the intervertebral joints are solely gliding and each joint allows of only a very slight movement, but when the sum of these slight individual movements is taken, the total range of movement of the spine as a whole is very considerable.

### Special Vertebral Joints.

**OCCIPITO-ATLANTAL** This is the joint between the base of the skull (occipital bone) and the first vertebra (atlas). As the atlas has no "body," but merely consists of a ring of bone, there can be no intervertebral disc between it and the skull, or between it and the second vertebra. The only articulations of the atlas with the skull are two joint surfaces situated where the transverse process of the vertebra joins the main ring of bone. These articular surfaces are very broad and articulate with corresponding surfaces at the base of the skull, on each side of the foramen magnum of the occipital bone. Movements at these joints are flexion and extension only.

**ATLANTO-AXIAL** This is the union between the first vertebra (atlas) and the second (axis). Besides the usual joints between the transverse processes of these bones, there is a special

articulation between the odontoid process of the axis and the anterior part of the ring of the atlas

It will be remembered that the axis has a process of bone which projects upwards into the ring of the atlas this is held in position against the anterior part of the atlas by means of a powerful transverse ligament passing across the ring of the atlas, which thus divides the ring into two parts (i) a small anterior compartment into which fits the odontoid process of the axis, and (ii) a larger posterior compartment through which passes the spinal cord. The atlas is in this way pivoted on the odontoid process of the axis, and the movement at this joint is, therefore, one of rotation, the atlas being able to rotate round the odontoid process and carry the skull with it (See Figs 10 and 11)

It is of interest to note that it occasionally happens that the transverse ligament confining the odontoid process is ruptured accidentally, and in that event the process is forced back into the spinal cord and causes instant death. This is the usual cause of death in judicial hanging

### Lower Jaw.

The Temporo-maxillary joint is formed by the upper articular surface of the condyle of the lower jaw and the articular surface of the temporal bone at the base of the zygoma. It is situated immediately in front of the ear. The joint is peculiar in that a disc-like piece of cartilage is interposed between the two bones, and so a form of double joint is formed. There are two synovial membranes, one above and one below this Intra-articular disc. The joint is surrounded by a capsular ligament enclosing the whole joint, and in addition there are one or two accessory ligaments, viz. Internal lateral ligament passing from the inner surface of the ascending ramus of the jaw to the base of the skull, and a stylo-mandibular ligament passing from the angle of the jaw backwards and upwards to the base of the skull (attached to the styloid process of the sphenoid bone)

**MOVEMENTS OF THE JOINT** The movements of the joint are complicated, but briefly they are—

- (i) A hinge-like movement in the lower compartment of the joint

(ii) A gliding movement in the upper compartment. Excessive movement is partly prevented by an eminence of bone in front of the articular surface on the temporal bone (called the *Eminentia Articularis*), which projects downwards in front of the joint. Sometimes the condyle of the jaw slips over this and becomes dislocated. This may occur solely by muscular action, e.g. in an exaggerated yawn.

### Articulation of Ribs.

These are unimportant, and need not be described in detail. Each rib articulates behind with the corresponding dorsal vertebra. There are generally two articulations—

- (i) between the head of the rib and the body of the vertebra, and
- (ii) between an articular surface on the shaft of the rib about an inch from the head and the tip of the transverse process of the vertebra. In front the first ribs articulate by means of the costal cartilages with the sides of the sternum. The costal cartilages of the 8th, 9th, and 10th articulate with the costal cartilage of the rib immediately above them, and are therefore only indirectly attached to the sternum. The 11th and 12th ribs have no articulation in front.

**MOVEMENTS OF RIBS.** The movements of the rib articulations are of extreme importance as on them depend the power of respiration. Each rib is to be regarded as forming the arc of a circle, and rotates on an axis passing through each extremity (the axis of rotation being the chord of the arc). In this way, as the point of maximum curvature of the rib rises, it increases the cubic contents of the thorax, and so air is inspired. When the ribs fall the thoracic capacity is diminished and air is expelled. It is to be noted, however, that this movement of the ribs is complicated by the fact that the sternum itself moves forwards during respiration.

### Articulation of Pelvis.

Apart from the articulation of the hip joints, there are five joints associated with the pelvis. These are—

- 1 Lumbo-sacral. The joint between the lowest lumbar vertebra and the upper surface of the sacrum.
- 2 and 3 The Sacro-iliac joints, two in number, between the sacrum and the iliac bones.

4 The Symphysis pubis, between the two pubic bones

5 The Sacro-coccygeal joint, between sacrum and coccyx

1 LUMBO-SACRAL JOINT As this is practically identical with the ordinary intervertebral articulations, no detailed description is necessary

2 and 3 SACRO-ILIAC JOINTS Formed by the union of the sacrum and ilium on each side Each joint is formed by ear-shaped pieces of cartilage on the sacrum and ilium respectively, and these are more or less firmly bound together by patches of fibrous tissue. At the upper and back part of the joint the two surfaces are tightly bound together by fibrous tissue (the sacro-iliac ligament) The joints are situated, one on each side of the upper part of the sacrum, and the iliac articular surface overlaps the sacral surface behind, so that in reality the sacrum may be regarded as almost slung between the two iliac bones

*Movement* A very slight gliding movement is all that takes place at these joints

4 SYMPHYSIS PUBIS The two pubic bones are joined together in front by a piece of fibro-cartilage which unites the cartilaginous covering of the bones In addition to the fibro-cartilage, ligaments assist in holding the bones together These ligaments are strong fibrous bands connecting the bones round the whole circumference of the articular surfaces There is no real articular cavity as this is filled with the fibro-cartilage

5 SACRO-COCYGEAL This is a small joint between the lower end of the sacrum and the coccyx The bones are tightly connected with fibro-cartilage, and there is no true joint cavity

### Ligaments of the Pelvis.

In addition to the ligaments found in the immediate neighbourhood of the joints, there are other powerful bands of fibrous tissue which assist in maintaining the rigidity of the pelvis The most important of these are the *Greater and Lesser Sacro-sciatic Ligaments*

The Great Sacro-sciatic ligament is triangular in shape, and its base is attached to the side of the sacrum It then passes across the interval between the sacrum and ischium, and is attached by its apex to the tuberosity of that bone

The Lesser Sacro-sciatic ligament arises from the side of the

sacrum, in front of the greater sacro-sciatic ligament, and passes across to the spine of the ischium (a projection of bone on the body of the ischium, about an inch higher than the tuberosity)

### Joints of the Upper Extremity.

**CLAVICULAR JOINTS** The clavicle unites at its inner end with the cartilage of the first rib, and the upper and outer angle of the sternum. This is the *Sterno-clavicular Joint*, and is one of those joints with an interarticular cartilage. This cartilage is interposed between the articular cartilages of the sternum and clavicle. In addition to the usual capsular ligament there is a powerful band of fibrous tissue connecting the inner end of the clavicle to the first rib, called the *Rhomboid Ligament*.

*Movements* The sterno-clavicular joint is the centre of all movements of the shoulders. The clavicle is the only bony attachment of the arm to the trunk, and at its articulation with the sternum movements in all directions are possible, but not to any very great extent.

**ACROMIO-CLAVICULAR** The outer end of the clavicle unites with the acromion process of the scapula to form this joint. It is a small joint, but the clavicle and acromion process are held firmly together by means of the capsular ligament of the joint, and by means of some additional very powerful ligaments which connect the clavicle with the coracoid process of the scapula. These are called the *Coraco-clavicular Ligaments*, and are two in number, the *Trapezoid* and *Conoid Ligaments*. These ligaments give rigidity to the articulations between the clavicle and scapula.

*Movements* at this joint are chiefly gliding and are slight in extent.

**SHOULDER JOINT** This is a ball and socket joint, and is formed by the head of the humerus and the glenoid cavity of the scapula. The joint surfaces are very loosely fitting, and the bones are held in position by powerful ligaments and muscles which pass from one bone to the other. The capsular ligament is very lax and allows great freedom of movement. This ligament is strengthened in places by strong fibrous bands, of which the most important is the *Coraco-humeral Ligament*, passing from the coracoid process of the scapula to the upper part of the neck of the humerus. A peculiar feature

of this joint is that the long tendon of the biceps passes through the joint and gets a covering from the synovial membrane. This tendon acts as a powerful ligament in maintaining the bones in position

*Movements.* The shoulder joint can be moved in all directions with the greatest freedom. Powerful muscles pass from the scapula

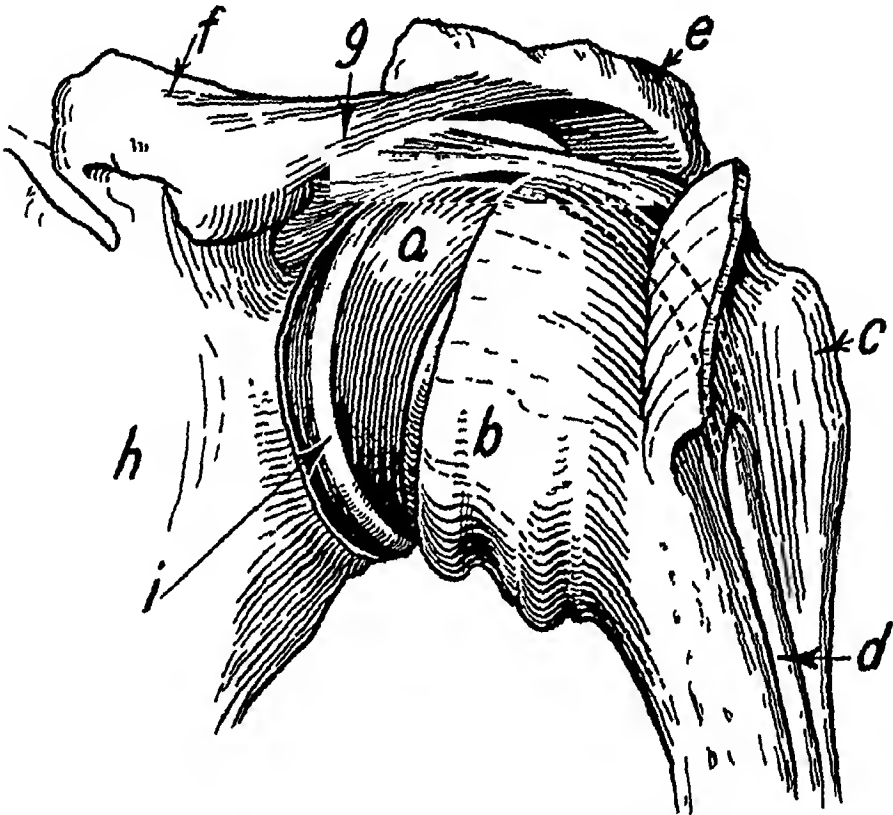


FIG 17—SHOULDER JOINT PARTLY EXPOSED

a = Head of humerus  
 b = Capsule of joint divided to expose the head of the bone  
 c = Greater tuberosity of humerus  
 d = Tendon of biceps continued beneath the capsule across the top of the head of the humerus to be inserted into the upper part of the glenoid cavity

e = Acromion process of the scapula.  
 f = Coracoid process of scapula  
 g = Coraco acromial ligament  
 h = Scapula  
 i = Edge of glenoid cavity

and chest wall to the humerus and form a covering for the joint everywhere except below. It is to be observed that in movements of the humerus the scapula plays a very important part, and moves with that bone in many of the movements of the arm. Thus in upward and forward movements the scapula moves with the humerus, and these two bones are steadied in their movements by

the clavicle, and in fact, as stated above, pivot on the sterno-clavicular articulation

**ELBOW JOINT.** This is a complicated joint formed by three bones, namely, the humerus, the ulna, and the radius

The inner portion of the articular surface of the humerus unites

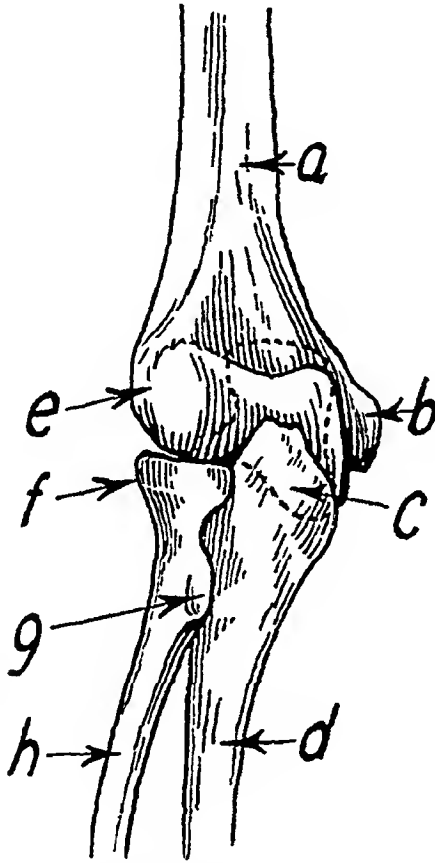


FIG 18—ELBOW JOINT (FRONT VIEW)

The dotted portion is the olecranon process of the ulna lying behind the joint

- |                                    |  |
|------------------------------------|--|
| a = Humerus                        | f = Head of radius                         |
| b = Internal epicondyle of humerus | g = Bicipital tuberosity of radius for the |
| c = Coronoid process of ulna       | insertion of the biceps tendon             |
| d = Ulna                           | h = Radius                                 |
| e = External epicondyle of humerus |  |

with the ulna and the outer portion with the radius. There is also a joint between the head of the radius and the ulna, called the *Superior Radio-ulnar Joint*

The articular surface of the upper end of the ulna is roughly semi-cylindrical in shape and fits closely on to the humerus so that movement is allowed in only one plane—viz forwards and backwards, or flexion and extension



The upper end of the radius, however, is disc-like in shape with a slightly depressed centre. This fits loosely into the outer part of the articular surface of the humerus and not only allows the radius to move forwards and backwards with the ulna, but permits it to rotate on its own axis. The ligaments holding the radius and ulna in apposition to the humerus are complicated, but briefly, they consist of a capsular ligament attached to the margin

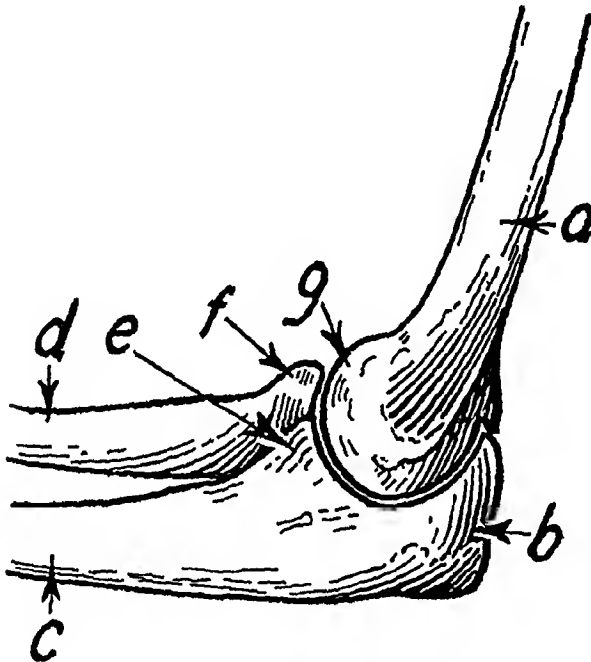


FIG 19 — ELBOW JOINT (SIDE VIEW)

a = Humerus  
b = Olecranon process of ulna  
c = Ulna  
d = Radius

e = Coronoid process of ulna  
f = Head of radius  
g = Articular surface of humerus

of the articular surface of the ulna and also to the lower end of the humerus so as to enclose the joint completely, except at one spot where the radius passes through it. Here the capsular ligament is thickened so as to form a band round the neck of the radius immediately below the articular head. This thickened band is called the *Orbicular Ligament*, and is firmly attached to the ulna and so binds the radius to it, but at the same time allows this bone free rotatory movement. The capsular ligament of the elbow joint is strengthened by external and internal lateral ligaments, one on each side.

**SUPERIOR RADIO-ULNAR JOINT** The head of the radius is in close contact with the upper end of the ulna, and the edge of the disc-like radial head articulates on its inner side with the ulna. This is necessary as in rotation of the radius the ulna remains fixed. A synovial membrane lines the joint and is continuous with that of the elbow joint.

*Movements* No side-to-side movements are possible in the elbow joint owing to the pure hinge-like form of the ulnar-humeral articulation. Flexion and extension occur at the ulnar-humeral part of the joint and also at the radio-humeral part, and in these movements both bones move together. The movement at the radio-ulnar joint is solely one of rotation of the head of the radius, the edge of the disc-like head gliding against the ulna. This movement occurs when the hand is laid palm downwards (pronation) or palm upwards (supination).

**WRIST JOINT** This is formed almost entirely by the lower end of the radius and the carpal bones. The lower articular surface of the radius is, roughly, triangular in shape with the apex outwards. The base lies on the inner side, and to it is attached a triangular piece of fibro-cartilage, attached by its base to the inner border of the radial articular surface, and by its apex to the styloid process of the ulna. In this way the lower end of the ulna is separated from the wrist joint proper. The carpal bones entering into the formation of the wrist joint are the *Scaphoid*, *Semilunar*, and *Cuneiform* bones. The wrist joint is lined by a synovial membrane which is sufficiently lax to allow free movement. The capsular ligament encloses the whole joint, and is strengthened on the inner and outer sides, forming the internal and external lateral ligaments. The strength of the joint is maintained largely by the numerous tendons passing over it from the muscles of the forearm to the fingers and hand.

*Movements* Movements at the wrist are free, extension, flexion, abduction, and adduction all being present.

With regard to flexion and extension, an important point demonstrating the effect of tendons passing over a joint on the movement of that joint is shown. If the fingers are fully extended flexion of the wrist is possible to an extent 20° or 30° greater than is the case if the fingers are flexed. This is due to the fact that flexing of the

fingers puts the extensor tendons on the back of the hand on the stretch, and so prevents full flexion of the wrist. Were full flexion under these conditions attempted, it would cause great pain by over-stretching the extensor tendons.

**INFERIOR RADIO-ULNAR JOINT.** This is the joint between the lower end of the radius and the ulna. The articular surface of

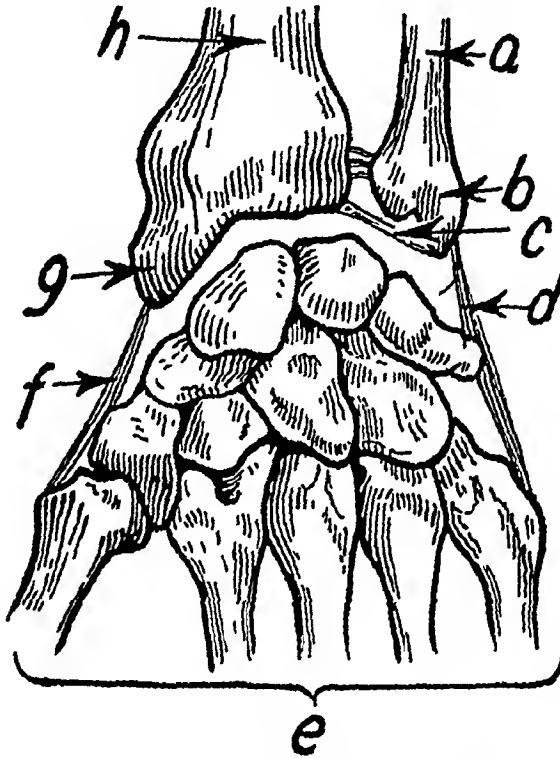


FIG 20 —WRIST JOINT (FRONT VIEW)

- a* = Ulna.
- b* = Styloid process of ulna
- c* = Triangular fibro-cartilage separating the lower end of the ulna from the main wrist joint
- d* = Lateral ligament
- e* = Metacarpal bones
- f* = Lateral ligament
- g* = Styloid process of radius
- h* = Radius

the radius is found on the inner side of the lower end of the bone, its lower border corresponding to the base of the triangular surface described above as forming the radial articular surface of the wrist joint. The ulnar articular surface is the head of that bone, which, on its outer side, articulates with the radius, and the lower surface of the ulna head lies in contact with the triangular cartilage of the wrist joint. The synovial membrane of the joint is separate from that of the wrist.

*Movements* at this joint are purely those of rotation of the lower end of the radius round the head of the ulna. This movement takes place during pronation and supination of the hand. (See Fig 13.)

**CARPAL ARTICULATIONS** These need not be described in detail. All the bones of the carpus are separated by one synovial membrane, which ramifies between the bones and covers them, except in front and behind, and except where the strong fibrous bands holding the bones together are situated.

*Movements* are of a gliding character only, and are useful in increasing the suppleness of the hand.

**CARPO-METACARPAL AND INTERPHALANGEAL ARTICULATIONS** These call for no special description. The first carpo-metacarpal joint is that of the thumb, which is distinct from the others. The 2nd, 3rd, 4th, and 5th joints have a common synovial membrane which is usually continuous with the carpal synovial membrane.

*Movements* at the carpo-metacarpal joints are those of flexion and extension with, in addition, a lateral movement, e.g. when the fingers are widely separated.

The movements of the interphalangeal joints are those of flexion and extension only.

### Joint of the Lower Extremity.

**HIP JOINT** This is formed by the head of the femur and the acetabular cavity of the pelvis. It is the most powerful joint in the body and its great strength lies in

(i) the very close apposition of the articular surfaces, the head of the femur fitting very tightly into the acetabular cavity (like a ball in a cup), and

(ii) the very powerful ligaments holding the bones in position.

The bony acetabular cavity is not very deep, but the edge of the bone is, as it were, built up by fibrous tissue which forms a ringlike ligament, called the *Cotylod Ligament*, which greatly deepens the joint cavity, and at the same time closely embraces the head of the femur without being actually attached to it.

In addition to this ligament there is a band of fibres (*Ligamentum Teres*) of great strength attached to a relatively wide area in the hollow of the acetabulum, and passing out to the head of the femur. The fibres taper as they pass outwards, and are attached to the head

of the femur at about its centre In this way excessive movement of the bone is prevented

The capsular ligament is attached all round the acetabulum and

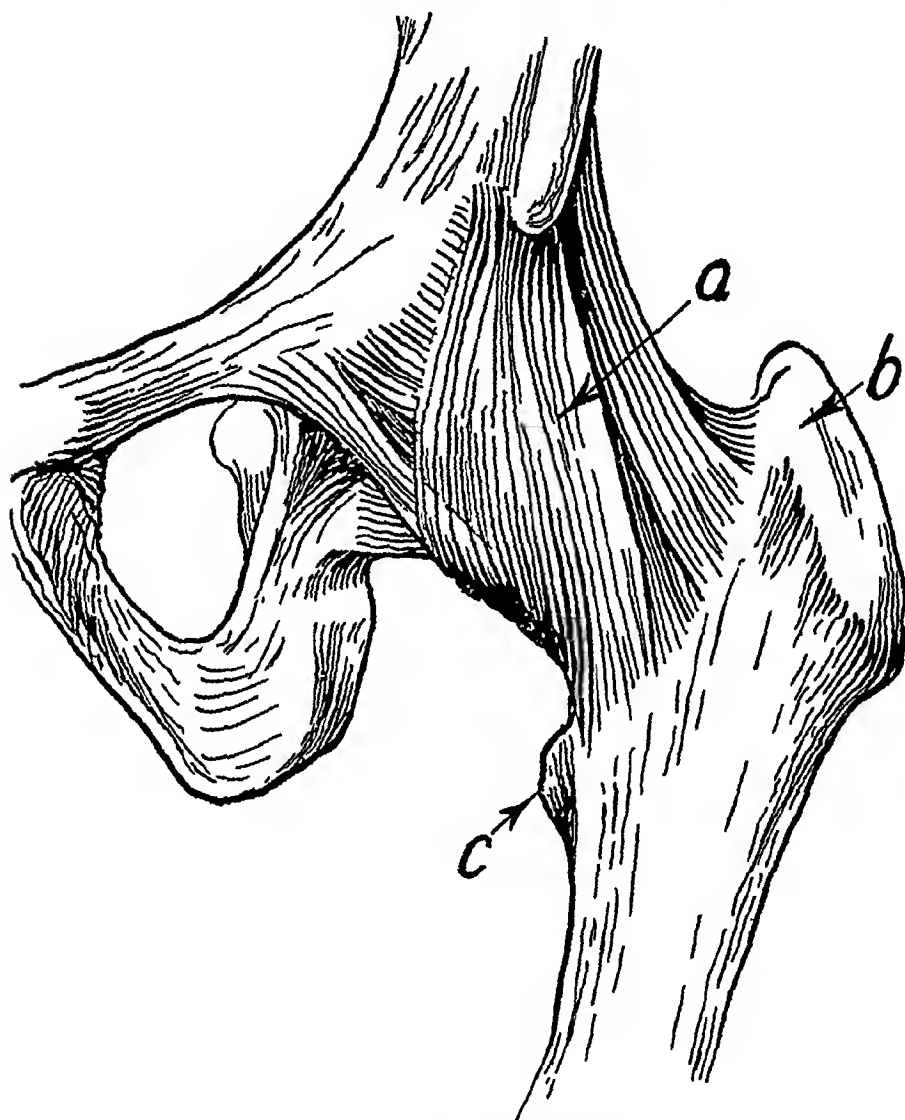


FIG 21 —HIP JOINT (EXTERIOR)

a = Fibrous ligaments covering the capsule of the joint  
b = Great Trochanter  
c = Lesser Trochanter

completely envelopes the head and neck of the femur, being attached to the base of the neck of this bone just near the greater and lesser trochanters, where the neck joins the shaft The capsule is completely lined by synovial membrane

Another very powerful ligament is the *Ilio-femoral Band* This

is attached to the ilium just above the hip joint (to the anterior inferior spine of the ilium), and expands below to form two powerful bands inserted, one into the upper part of a roughened ridge (the

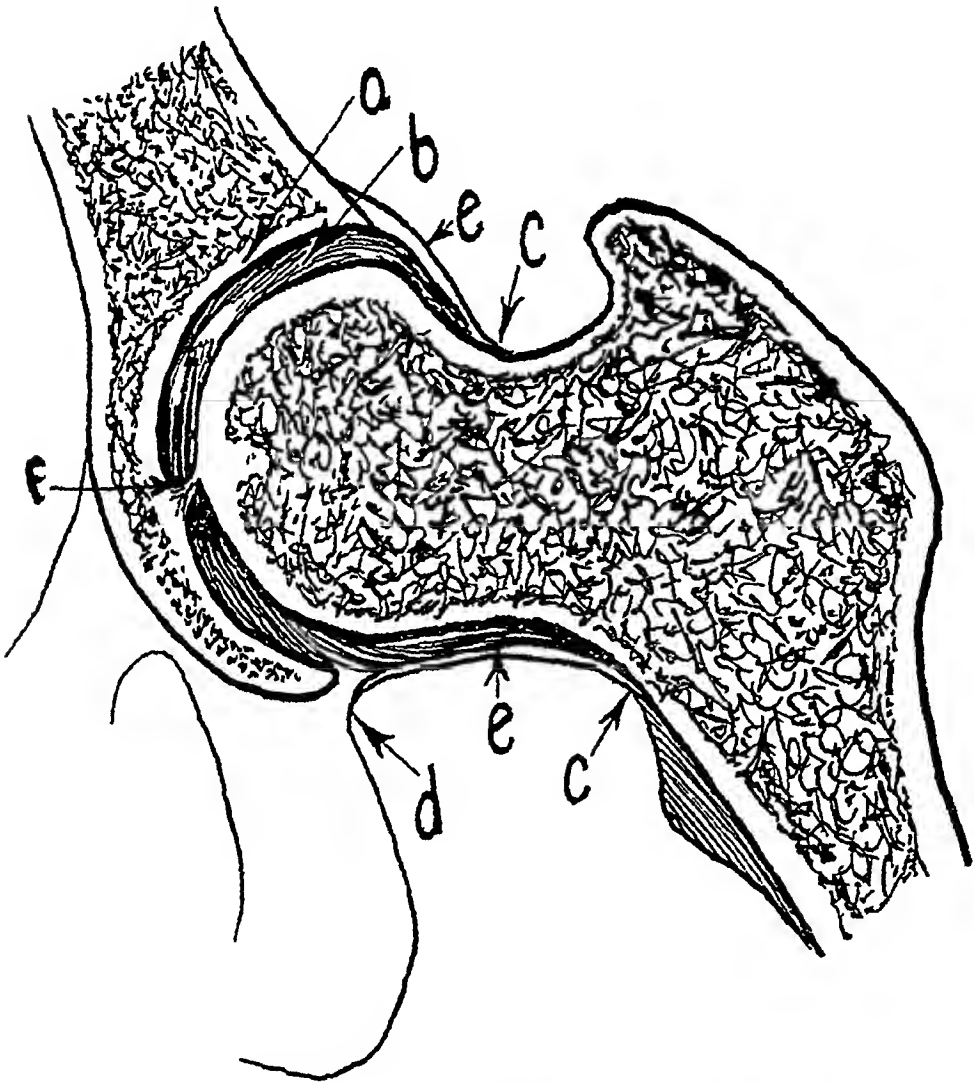


FIG 22—INTERIOR OF HIP JOINT

- |   |   |
|---|---|
| a = Acetabulum  | d = Attachment of capsule to the pelvis |
| b = Cavity of joint   | e = Capsule of joint                    |
| c = Attachment of capsule of the joint to the neck of the femur | f = Ligamentum teres                    |

*Anterior Intertrochanteric Line*) which passes from the greater to the lesser trochanter in front of the bone, and the other into the lower part of this line. The ligament is therefore shaped like an inverted Y, and is sometimes called the Y-shaped ligament. This ligament is of great importance, as it is largely due to it that

excessive backward tilting of the pelvis is prevented. If the thigh bone is held rigid, the pelvis cannot tilt backwards unless this ligament is ruptured.

There are other strong ligamentous bands connecting the femur and pelvis, but these need not be described in detail.

*Movements* at the hip joint are extremely free. It is a ball and socket joint, and therefore freedom of movement is possible in all directions. The extent of these movements is chiefly limited by the ligaments of the joint.

**KNEE JOINT** This is the most complicated of the joints. Three bones enter into its formation, namely, the Femur, Tibia, and Patella.

The *Patella* lies in front and is practically embedded in the tendon of the large muscle (*Quadriceps*) of the front of the thigh. The posterior surface of the patella is covered with articular cartilage, where it forms part of the knee joint.

The quadriceps muscle becomes tendinous above the patella, and this tendon sends out two sheets of fibres, one on each side of the patella, which surround the front and sides of the joint, and really form its capsular ligament. The main mass of the fibres of the tendon of the quadriceps pass onwards round the sides and over the front of the patella, and are continued below the patella to be inserted into the tubercle of the *Tibia*, a prominence of this bone just below its articular surface. The tendon is here called the Patellar ligament (*Ligamentum Patellae*). In this way it can be understood that the front of the joint is enclosed altogether by the patellar tendon of the quadriceps with its expansion and the patellar ligament.

The lateral ligaments are three in number, two external and one internal.

The two external (long and short) ligaments are both attached to the femur and the head of the fibula. The internal lateral ligament is attached to the internal condyle of the femur above, and to the inner surface of the upper end of the shaft of the tibia below. It is of some interest to note that this ligament is firmly attached to the Internal Semilunar cartilage (see below).

*Posterior Ligament* This is a strong ligamentous sheet, attached to the femur and tibia, and encloses the joint behind.

*Interior of the Joint* This is of considerable complexity owing to the presence of the two semilunar cartilages and the crucial ligaments

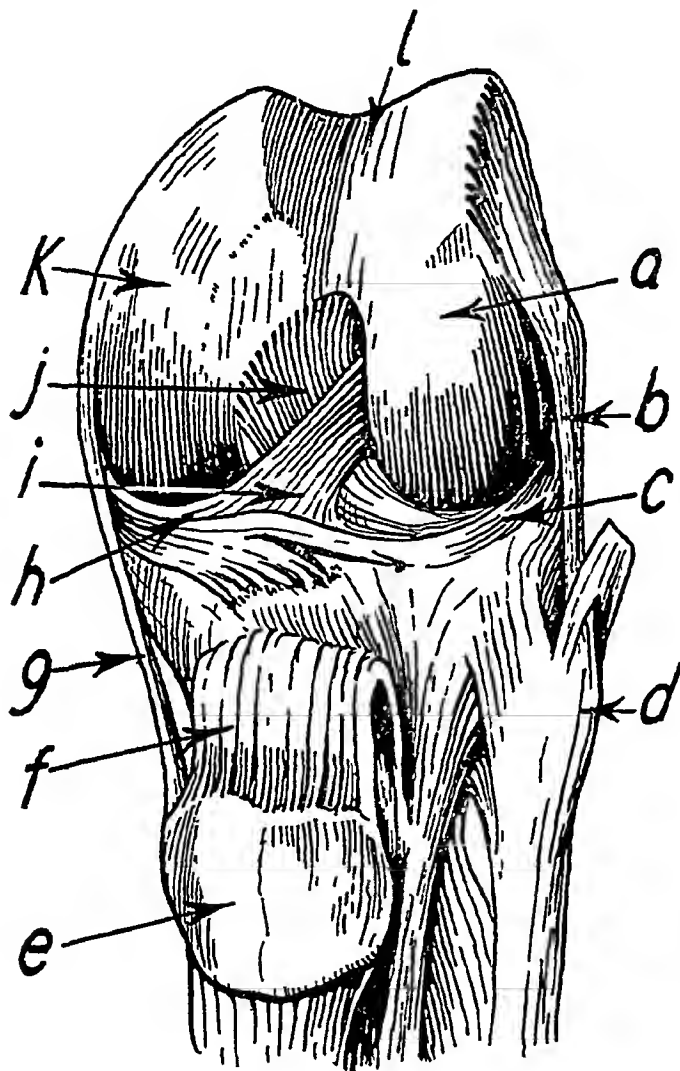


FIG 23 —KNEE JOINT  
(FRONT VIEW OF INTERIOR WHEN FULLY FLEXED)

The patella has been turned down

- |  |   |
|--|---|
| a = External condyle of the femur  | f = Patellar tendon                         |
| b = External lateral ligament  | g = Internal lateral ligament               |
| c = External semilunar cartilage   | h = Internal semilunar cartilage            |
| d = Head of fibula   | i = Anterior cruciate ligament              |
| e = Articular surface of the patella which has been turned down from its normal position | j = Posterior cruciate ligament             |
|  | k = Internal condyle of femur               |
|  | l = Groove normally occupied by the patella |

*Semilunar Cartilages* In order to appreciate the position and function of these, it must be remembered that the upper articular surface of the tibia is, roughly, an oval with a constriction in the



middle so as to form two separate halves, rather like two three-quarter circles joined together. Lying round the edge of each of these three-quarter circles is a "semilunar cartilage"

Each semilunar cartilage is shaped very much like a sickle with its sharp edge looking towards the centre of the joint. Each cartilage, therefore, has two pointed extremities attached near the middle of the joint to the upper surface of the tibia, and the thickened outer edge of each cartilage is attached to the border of the corresponding articular surface of the tibia. The inner sharp border of the cartilage lies free in the joint. In this way each cartilage tends to fill in the gap between the rounded surface of the condyle of the femur and the flat upper surface of the tibia.

The cartilages can be removed without seriously impairing the strength of the joint, but it can be easily understood that, if one end or other of one of these cartilages becomes loose and the cartilage gets bent or twisted, serious results in the use of the joint follow.

*Crucial Ligaments* These are two ligaments lying entirely within the joint. They are attached below to the upper surface of the tibia, one on each side of the middle line. They are inserted above into the deep groove which is present between the condyles of the femur, but they cross each other in their passage across the knee joint, so that the ligament arising to the right of the middle line of the upper tibial surface is inserted into the left-hand side of the intercondylar groove, and vice versa. The function of the ligaments is rather obscure, but they limit full flexion and rotation.

*Synovial Membrane* This is very complicated in the knee joint, and extends upwards in a large pouch beneath the quadriceps muscle. It is attached all round the articular cartilages, and also sends out prolongations at various points between the ligaments, and these form little pouches, containing synovial fluid and act as cushions over which the tendons round the joint can move in freedom. These pouches are called *Bursae*, are found in the neighbourhood of other joints, and are frequently completely shut off from the joint. Similar bursal sacs containing fluid are found in many parts of the body where tendons or muscles pass over bony prominences.

*Movements of the Knee Joint* Flexion and extension are the main movements that take place at this joint, but a slight degree

of rotation is also possible, and in fact, always occurs (in an outward direction) when the knee joint is fully extended. The patella, during these movements, glides over the condyles of the femur, and it is through this bone, which acts as a fulcrum, that the leverage is executed by the quadriceps muscle on the tibia. It will be noted that when the knee is semi-flexed the patella lies over the most prominent parts of the condyles, and it is in this position that it is subjected to the greatest strain. The result of this strain is sometimes seen when a man, trying to save himself from falling when the knee is half bent (as it usually is when he has half fallen), suddenly throws the whole force of his quadriceps muscle into an attempt to straighten the leg, and the patella, unable to stand the strain, snaps across the femoral condyles.

**ANKLE JOINT** Three bones enter into the formation of this joint, viz tibia, fibula, and astragalus.

The ankle joint is a hinge joint, and is formed by the body of the *Astragalus* fitting into the mortise-like cavity formed by the lower end of the tibia and the fibula. The outer part of this mortise is formed by the expanded lower end of the fibula (*External Malleolus*) and the

upper and inner parts by the articular surface of the lower end of the tibia, of which the internal malleolus is a part. The lower end of the fibula is tightly bound to the tibia by a powerful but very short ligament (the *Inferior Tibio-fibular Ligament*). The body of the astragalus is roughly in the form of a cube with a convex upper surface. The articular cartilage covers this surface

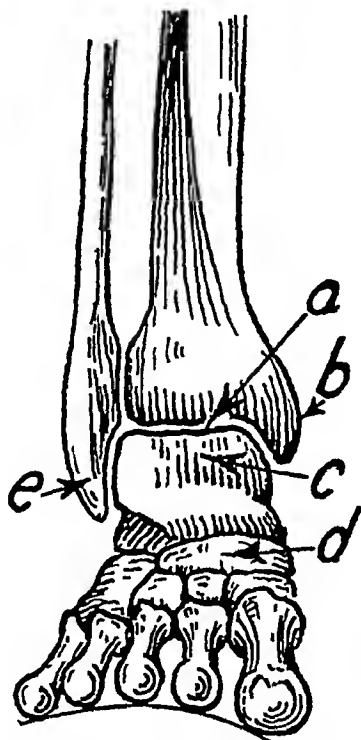


FIG 24 —THE ANKLE JOINT AND FOOT (SEEN FROM IN FRONT)

- a = Joint between tibia and astragalus (ankle joint)
- b = Internal malleolus
- c = Astragalus
- d = Navicular or scaphoid bone
- e = External malleolus

The phalanges of the toes have been omitted so as to show the transverse arch formed by the heads of the metatarsal bones (shown by the curved line)

and extends downwards on each side of the body, where it comes in apposition with the internal and external malleoli of the ankle

The bone surfaces are held together by a capsular ligament which completely envelopes the joint and is thickened to form an internal and external lateral ligament and an anterior and posterior ligament. The internal ligament is of great importance, and is a fan-shaped ligament attached above to the internal malleolus and spreading out below to be inserted into the navicular bone, the os calcis and the astragalus.

The external lateral ligament is divided into three parts, all attached above to the external malleolus, and the anterior division

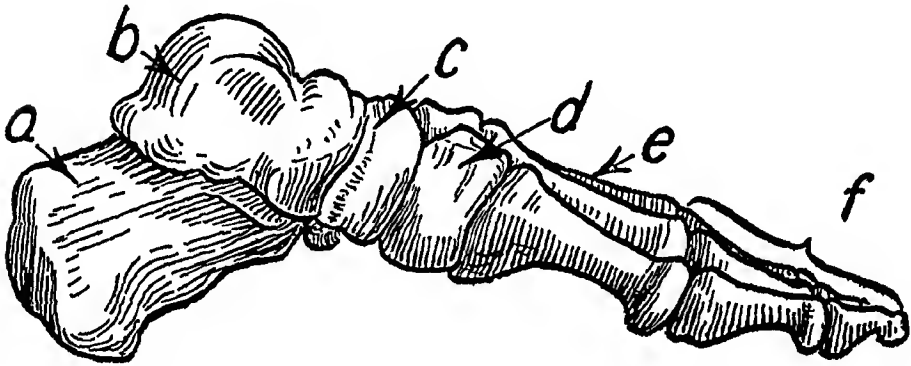


FIG 25—SKELETON OF THE FOOT, SHOWING ITS  
ARCHED FORM

a = Os calcis  
b = Astragalus  
c = Scaphoid

d = Internal cuneiform  
e = Metatarsal bones  
f = Phalanges

is inserted into the front of the astragalus, the posterior division to the back of the astragalus, and the middle division to the os calcis.

*Movements* These are chiefly those of extension and flexion, but a slight lateral movement is allowed. The chief lateral movements of the foot do not take place at the ankle joint, but at the joints between the tarsal bones.

THE TARSAL AND METATARSAL JOINTS need not be described in detail, but it is appropriate here to draw attention to the very important ligaments which strengthen the foot.

It will be remembered that the bones of the foot are arranged so as to form two arches, (1) an arch more marked on the inner side of the foot and formed by the os calcis behind and the navicular and

cuboid immediately in front of this, and then the cuneiforms and metatarsals, and at the apex of this arch is the astragalus through which the whole weight of the body is transmitted, and (ii) an arch much less marked, across the front of the foot formed owing to the three middle metatarsals being a little raised from the first and fifth (See Fig 24)

The most important ligaments of the foot are those supporting the first arch mentioned above, and they are named—

- 1 The Long Calcaneo-cuboid (Long Plantar) ligament
- 2 The Short Calcaneo-cuboid (Short Plantar) ligament, and
- 3 The Internal Calcaneo-navicular ligament

*The Long Plantar Ligament* passes from the os calcis behind to the cuboid in front, and in addition sends out several "branches" which are attached to the 2nd, 3rd, and 4th metatarsal bones

*The Short Plantar Ligament* passes from the front of the os calcis to the cuboid bone, and lies between the long plantar ligament and the bones of the foot

*The Calcaneo-navicular Ligament* is the most important ligament in supporting the arch of the foot, as it passes from the os calcis to the navicular bone, and on it rests the head of the astragalus. It is on the strength of this ligament that the integrity of the arch of the foot largely depends, and if this gives way the foot becomes flattened out and a condition of "flat foot" results

It is important to notice in this connection that the tendons of some of the calf muscles pass behind the ankle joint and are inserted into the bones on the sole of the foot, and act very much like straps to assist the ligaments in the support of the arch

**THE TIBIO-FIBULAR JOINT** The fibula articulates with the tibia above and below. The superior tibio-fibular articulation is between

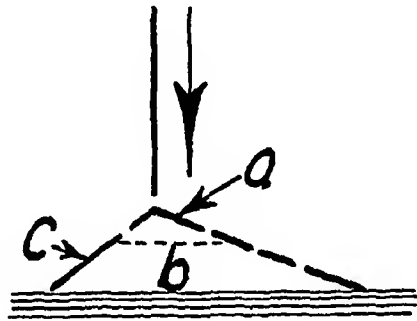


FIG 26—DIAGRAM TO ILLUSTRATE THE MECHANISM OF THE ARCH OF THE FOOT

The arrow represents the direction of the force due to the weight of the body

- a = Astragalus forming the apex or keystone of the arch
- b = A "tie" to prevent the arch collapsing, formed by the ligaments and tendons of the foot
- c = Os calcis (heel bone) forming the back pillar of the arch

the head of the fibula and the outer tuberosity of the tibia. This joint lies towards the back of the tuberosity and a little below it. Short but strong ligaments keep the bones in apposition. Very little, if any, movement takes place at the joint. The inferior tibio-fibular joint is that between the outer border of the lower end of the tibia and the lower end of the fibula, just as it is expanding to form the external malleolus. These two bones are tightly bound together at this joint by a powerful ligament (the inferior tibio-fibular ligament), and very little movement takes place. It is on the strength of the union of the two bones at this joint that the integrity of the ankle joint depends.

## CHAPTER IV

### PHYSIOLOGY OF THE JOINTS

THE function of all the main joints of the body is to allow movement of the bones which enter into their formation

From the brief account given in the last chapter, it will be seen that the range of movement is extremely variable, from the great freedom of joints such as the shoulder and hip, to the almost negligible movement in joints such as the sacro-iliac

The motive power acting on every joint is, of course, derived from the muscles and tendons which pass across the joint, and, being attached to fixed points on the bones, by their contraction cause movement to take place

In order that movement shall be free, three essential conditions must be present, namely—

- 1 Smooth opposing surfaces
- 2 Lubrication
- 3 Adaption of the joint surfaces to each other

(1) The smoothness of the articular surfaces is provided by the cartilage covering the bones. Cartilage is softer and smoother than bone and forms an ideal covering for the joint surfaces, its softness modifies and tends to dissipate jarring and its smoothness minimizes friction

(2) Lubrication is provided by the synovial fluid. This is a clear colourless liquid which is secreted by the synovial membrane in very small quantities, and its function is purely one of lubrication.

Any injury or inflammation of the synovial membrane is liable to cause it to secrete an excessive amount of fluid, and the joint then becomes filled and distended with fluid to such an extent as to impair its freedom of movement

(3) Adaptation of the joint surfaces is one of form, and in some cases, e.g. the hip and elbow, the opposing surfaces coincide most accurately. In others, such as the shoulder and knee, this adaptation is very much less marked, and it is noteworthy that joints

with the closest anatomical adaptation of their surfaces are less liable to dislocation than the others

### Action of Muscles on Joints.

The bald statement that a joint is moved by the contraction of a muscle, though perfectly true, conveys only a very imperfect

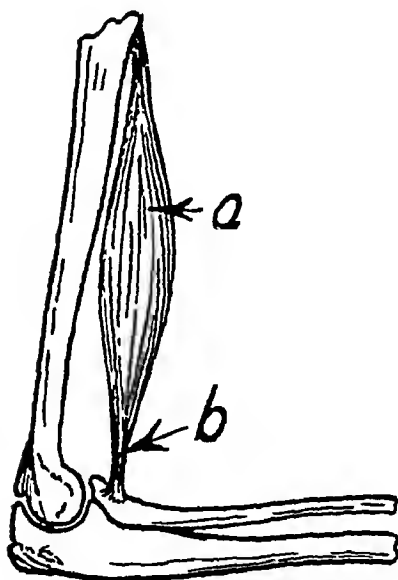


FIG 27—DIAGRAM TO ILLUSTRATE HOW A MUSCLE, BY CONTRACTION, FLEXES A JOINT

*a* = Muscle "belly"

*b* = Tendon

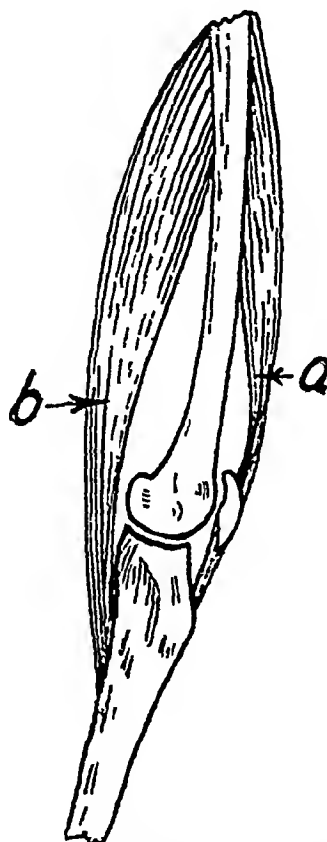


FIG 28—DIAGRAM TO ILLUSTRATE THE OPPOSITION AND BALANCING OF A FLEXOR AND EXTENSOR MUSCLE OF A JOINT

*a* = Extensor muscle    *b* = Flexor muscle.

idea as to the actual mechanism involved. Each joint is really like an extremely delicately-adjusted balance, and the forces maintaining this balance are provided by the tension of opposing groups of muscles.

Thus, in joints which have a free range, the following movements may take place—

- I. Flexion or bending, opposed by extension or straightening

2 Abduction or movement away from the middle line, opposed by adduction (movement towards the middle line).

3 External rotation opposed by Internal rotation

Each of these movements is carried out, as a rule, by a group of muscles acting in co-ordination. Thus, there is a flexor group opposed by an extensor group, etc. It is important to remember that all muscles are normally in a condition of "tone," i.e. are slightly on the stretch, so that were a tendon or muscle cut, a gap would appear (possibly  $\frac{1}{2}$  in long or more). Normally, therefore, there is no "slack" in the muscle, and the slightest contraction will at once be felt by the joint. Moreover, as *all* the muscles are in a state of tone, the flexor muscles for example, when they contract, will at once have to pull against the tone of the extensors.

This might appear to be an unnecessary waste of effort, but the actual result is that delicate movements can be performed smoothly and with every degree of fineness and accuracy, whereas were no opposing tension present, every movement would be by jerks.

Freedom of movement at a joint depends, therefore, not only on freedom of one group of muscles to contract, but also on the freedom of the opposing group to stretch. Damage, therefore, to an extensor muscle or tendon may result in inability to *flex* the joint owing to the extensor tendons or muscles being so scarred and adherent as to prevent any stretching taking place, and so the joint becomes fixed.



## CHAPTER V

### ANATOMY OF THE MUSCLES

THE muscles of the body are so numerous and complicated in their origin and insertion that it is not proposed to make any attempt at describing them all in detail

For our purpose it will be sufficient to indicate the main groups of muscles and to enumerate and describe the most important of these groups

#### General Structure of Muscles.

A muscle is composed of a vast number of muscular fibres, each of which is elongated and of minute breadth. The essential character of a muscle fibre is its contractile power

Muscles are divided physiologically into three classes—

*Voluntary muscle*, which is capable of contracting at the will of the individual

*Involuntary muscle*, which contracts without the conscious co-operation of the brain

*Heart muscle*, which is, of course, involuntary, but it has an internal rhythm and peculiar structure of its own

For a more detailed description of the difference in these muscles see Chapter VI. Involuntary muscle is found exclusively in the viscera, and in this chapter the skeletal or voluntary muscles only will be described.

**SKELETAL MUSCLES** The essential contractile part of these muscles, as mentioned above, consists of muscular fibres forming the main mass or "belly" of the muscle. In order to perform their function, which is that of producing movement of joints and other parts, they must be attached at each extremity. A muscle may be attached either directly to the part which it moves, or indirectly by means of a tendon (See Fig 27) A tendon, generally speaking, is a cordlike structure, composed of non-contractile but elastic fibres continuous at one end with the muscular fibres, but generally

decreasing in size, at first rapidly, and being then continued as a "cord" of tendinous fibres of more or less uniform diameter, until it gains its attachment to a bone

In some cases muscles are arranged in a sheet form (e g abdominal wall) and the tendinous portion of these is also sheet-like and forms a flat layer of tendinous fibres. Such a layer is called an *Aponeurosis*

If and when a tendon passes across a joint, it is held in position by ligaments passing over it, and as a rule is supplied with a tendon sheath, which consists of a layer of smooth synovial membrane (unconnected, as a rule, with that of the joint), containing a very small amount of synovial fluid, in order to give a smooth working channel in which the tendon can move

## MUSCLES OF HEAD, FACE, AND NECK

### Scalp.

Covering the periosteum of the skull from the eyebrows to the occipital region is the *Occipito-frontal Muscle* and aponeurosis. The main portion is the aponeurosis formed of a sheet of tendinous fibres, but in front and behind is a sheet-like layer of muscle. That in front is attached to the subcutaneous tissues over the frontal bones and the posterior muscle sheet is attached to the occipital bone and the mastoid process of the temporal bone. Its action is to raise the eyebrows and wrinkle the forehead and to move the whole scalp backwards and forwards

### Face.

The facial muscles are very small and are all chiefly attached to the subcutaneous tissue, and are essentially for the purpose of altering expression. Two only need be mentioned, and they are the *Orbicularis Palpebrarum* and the *Orbicularis Oris*

Both of these consist of muscle fibres arranged in a circle, the former round the orbit and the latter round the mouth. By their contraction they diminish the orbital and oral orifices as the case may be

### Eye.

*Vide Chapter XX*

## Lower Jaw.

The first function of the lower jaw is that of mastication, and there are several very powerful muscles attached to the jaw for this purpose—

1 **MASSETER** Arises from the zygoma, and is attached to the outer surface of the ramus of the lower jaw. Its action is to clench the teeth and close the jaws.

2 **TEMPORAL** This is a fan-shaped muscle arising from the side of the skull, from a semicircular space involving the upper part of the mastoid process, the lower part of the parietal bone and the outer angle of the frontal bone. Its fibres taper downwards, and are inserted by a tendon into the coronoid process of the lower jaw. Its action is to assist the muscles to close the jaw.

3 **INTERNAL PTERYGOID** This muscle corresponds roughly to the masseter, but lies on the inner side of the jaw instead of the outer. It arises from the base of the skull and is attached to the inner surface of the ramus of the jaw. Its action is similar to that of the masseter and temporal.

4 **EXTERNAL PTERYGOID** Arises from the skull immediately behind the upper jaw and passes backwards to be inserted into the condyle of the lower jaw. Its action is to draw the jaw forwards.

The above four muscles are the essential muscles of mastication, and by their action the teeth are brought into close apposition and the food is completely masticated by the rubbing action produced by the external pterygoid.

## Neck.

As there are nearly forty muscles (excluding small muscles of the vertebrae) in the neck region, no attempt will be made even to name them all here.

They may be roughly divided into three main groups—

- 1 Superficial
- 2 Anterior, including the tongue and all those acting on the larynx
- 3 Posterior, acting mainly on the spinal column

(1) **SUPERFICIAL MUSCLES** (a) *Platysma Myoides* This is a thin muscular sheet lying immediately beneath the chin and forming a practically continuous very thin layer of muscle fibre.

over the whole of the neck. It is extended downwards over the shoulder and chest and upwards over the lower jaw into the face,

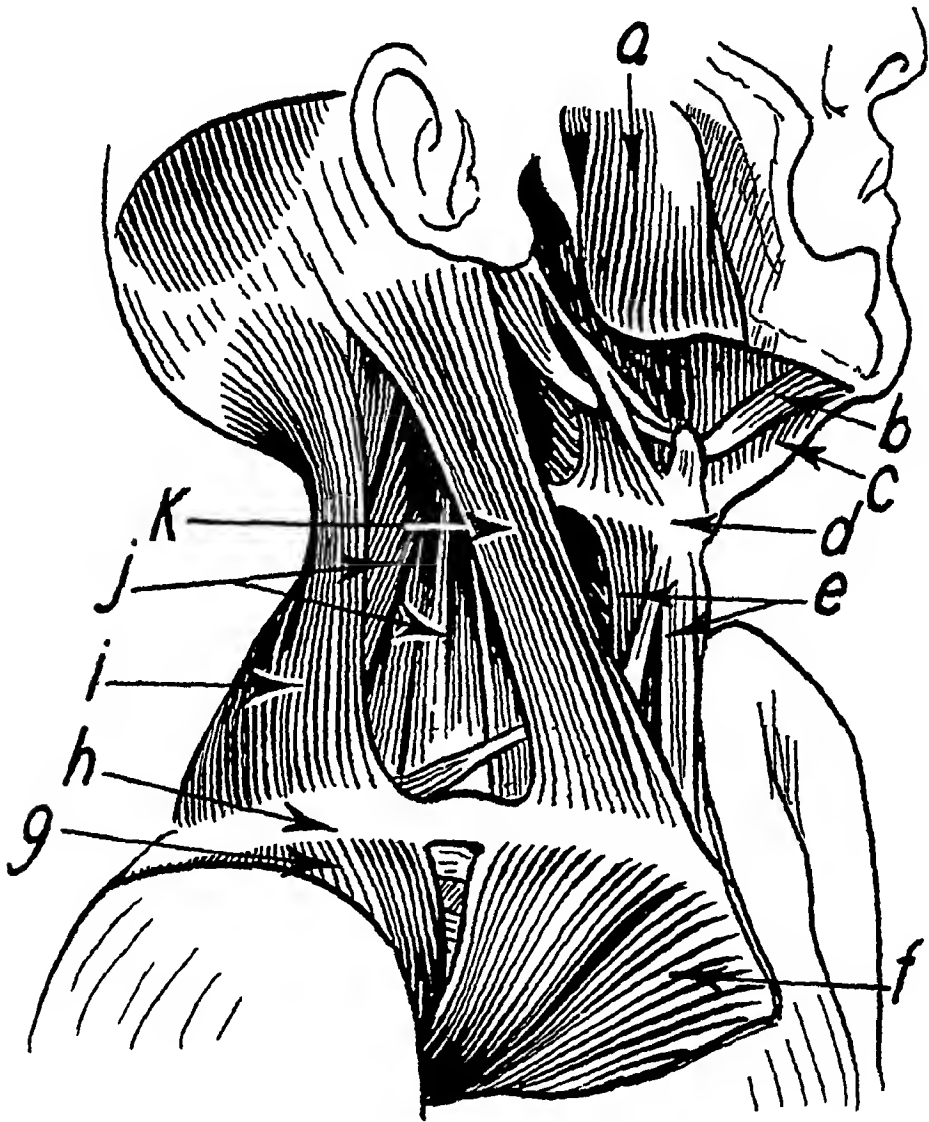


FIG 29—MUSCLES OF THE NECK AND NEIGHBOURING PARTS

- |                                       |                                    |
|---------------------------------------|------------------------------------|
| a = Masseter                          | g = Anterior fibres of the deltoid |
| b = Digastric (anterior belly)        | h = Clavicle                       |
| c = Mylo hyoid                        | i = Trapezius                      |
| d = Hyoid bone                        | j = Deep muscles of the neck.      |
| e = Infra hyoid muscles               | k = Sterno-mastoid muscle          |
| f = Upper portion of pectoralis major |                                    |

and its action is to tighten the skin of the neck. Its most obvious effect is to cause lowering of the skin at the corners of the mouth. It also assists in drawing down the lower lip, and depressing the lower jaw.

(b) *Sterno-mastoid* This is a large muscle placed obliquely on each side of the neck. Its rounded anterior border can be felt if the forehead is pressed forwards against the hand. It is attached above to the lower part of the mastoid process, and by a thin aponeurosis to a curved line on the outer part of the occipital bone. Below it is attached to two bones, viz. To the sternum, near the sterno-clavicular joint, by means of a rounded tendon, and secondly, to the inner third of the clavicle, this part of the muscle is flattened.

*Actions* Each muscle separately draws the back of the head downwards towards the shoulder of the same side, and at the same time tilts the chin upwards towards the opposite side. If both muscles act together they draw the head forwards and tilt the chin upwards.

*Relations.* The most important relation of the sterno-mastoid is to the *Common Carotid* and *External Carotid Arteries* and the *Internal Jugular Vein*. These vessels lie just beneath the rounded anterior border of the muscle.

2 ANTERIOR GROUP There are a large number of muscles in this group, and for convenience of description may be divided into two sub-groups, (a) those above the Hyoid bone and (b) those below.

(a) *Supra-hyoid Group* These muscles, lying above the hyoid bone and attached to it, are in close relation to the floor of the mouth, in fact the deeper ones actually form the floor of the mouth on their upper surface, being covered by the mucous lining of the mouth. They need not be described in detail, and their general action is to raise the hyoid bone and with it the tongue, whose root is attached to this bone, in the act of swallowing.

(b) *Infra-hyoid Group* This group is attached above to the hyoid bone and below to the sternum. Their action is to draw down the hyoid after it has been raised, and they are also sometimes brought into action in forcible respiratory movements, raising the sternum.

*Relations* The most important of these are to the *Trachea* (windpipe) which they practically surround, and to the larynx.

3 POSTERIOR GROUP These are the most powerful muscles of the neck, and are closely associated with the back muscles, acting chiefly on the spinal column. The group is arranged on each side

of the spinal column, and consist of two or three large and powerful muscles and a large number of small muscles passing from one vertebra to the next

The chief of the large muscles is the *Trapezius*. This muscle only half belongs to the neck as it arises as a sheet from the spines of all the dorsal and cervical vertebrae, and also from the occipital bone. From this wide origin the fibres converge and are inserted into the upper border of the spine of the scapula, to the acromion process and to the outer quarter of the clavicle.

The upper fibres of this muscle therefore form one of the chief connecting links between the shoulder and the neck, and this part of the muscle is largely responsible for all movements of raising the shoulders or keeping the scapula fixed with the arm raised.

A second important muscle is the *Levator Anguli-scapulae*. This is more deeply placed and arises from the transverse processes of four or five cervical vertebrae, and is inserted into the upper angle of the Scapula. Its chief action is to raise the scapula and to fix this bone in movements of the shoulder.

There are a large number of other powerful muscles, deeply placed in the back of the neck, all arising from the vertebrae and passing down the neck to the upper ribs, or upwards to the base of the skull. Their action is to control the movements of the cervical spine and head, and to assist in movements of the upper ribs in respiration.

### Muscles of the Back.

The muscles of the back include some of the most powerful muscles of the body. The trapezius, which lies partly at the back of the neck, has already been mentioned. Its lower part covers the posterior part of the thorax, and by its action the scapula is drawn backwards and towards the spine.

Two other powerful back muscles are worthy of special attention, namely, the *Latissimus Dorsi* and the *Erector Spinae*.

1 *LATISSIMUS DORSI*. This is a broad, flat muscle arising from the spines of the lower six dorsal vertebrae, all the lumbar vertebrae, the sacrum, and the posterior part of the crest of the ilium. Most of its origin is aponeurotic. From this origin the fibres converge as they pass outwards and upwards, and end in a powerful flattened

tendon which is inserted into the front of the upper part of the humerus. In its passage upwards the muscle passes across the lower angle of the scapula, and then passes round the armpit, of the posterior fold of which it forms one of the chief constituents.

*Action* The action of this muscle is to draw the arm downwards and backwards. It is concerned largely in the delivery of blows in a downward direction, e.g. with a chopper, or if the arms are fixed, it draws the whole body forwards, e.g. in climbing.

2 **ERECTOR SPINAE** This is a complicated muscle arising from the back of the sacrum and passing upwards, dividing as it goes into branches which are inserted into successive vertebrae and ribs. This muscle, although described separately, is the chief constituent of a mass of muscular fibres passing from vertebrae to vertebrae, and vertebrae to ribs all the way up the back. This great group of muscles lies beneath the latissimus dorsi and trapezius, and is responsible for holding the spine erect and in raising it from the stooping position. It is the muscle most frequently involved in a "strained back."

### Muscles of the Thorax.

Muscles confined entirely to the Thorax. The Intercostal Muscles and the Diaphragm are the chief of these.

(a) **INTERCOSTAL MUSCLES** These are arranged in pairs between each of the ribs. They are internal and external. The internal intercostal muscles consist of a band of short fibres attached above to the inner border of the lower margin of one rib, and below to the inner border of the upper margin of the next lower rib. The fibres pass downwards and backwards, and there are eleven of these muscles on each side, corresponding to the number of intercostal spaces.

The external intercostal muscles are attached to the outer border of the upper and lower margins of adjacent ribs and their cartilages, and the direction of their fibres cross those of the internal intercostals, being downwards and forwards. These muscles are also eleven in number on each side, and below become continuous with the anterior abdominal muscles.

The action of the intercostal muscles is to assist in respiration. The exact action of each group of these muscles is a subject of

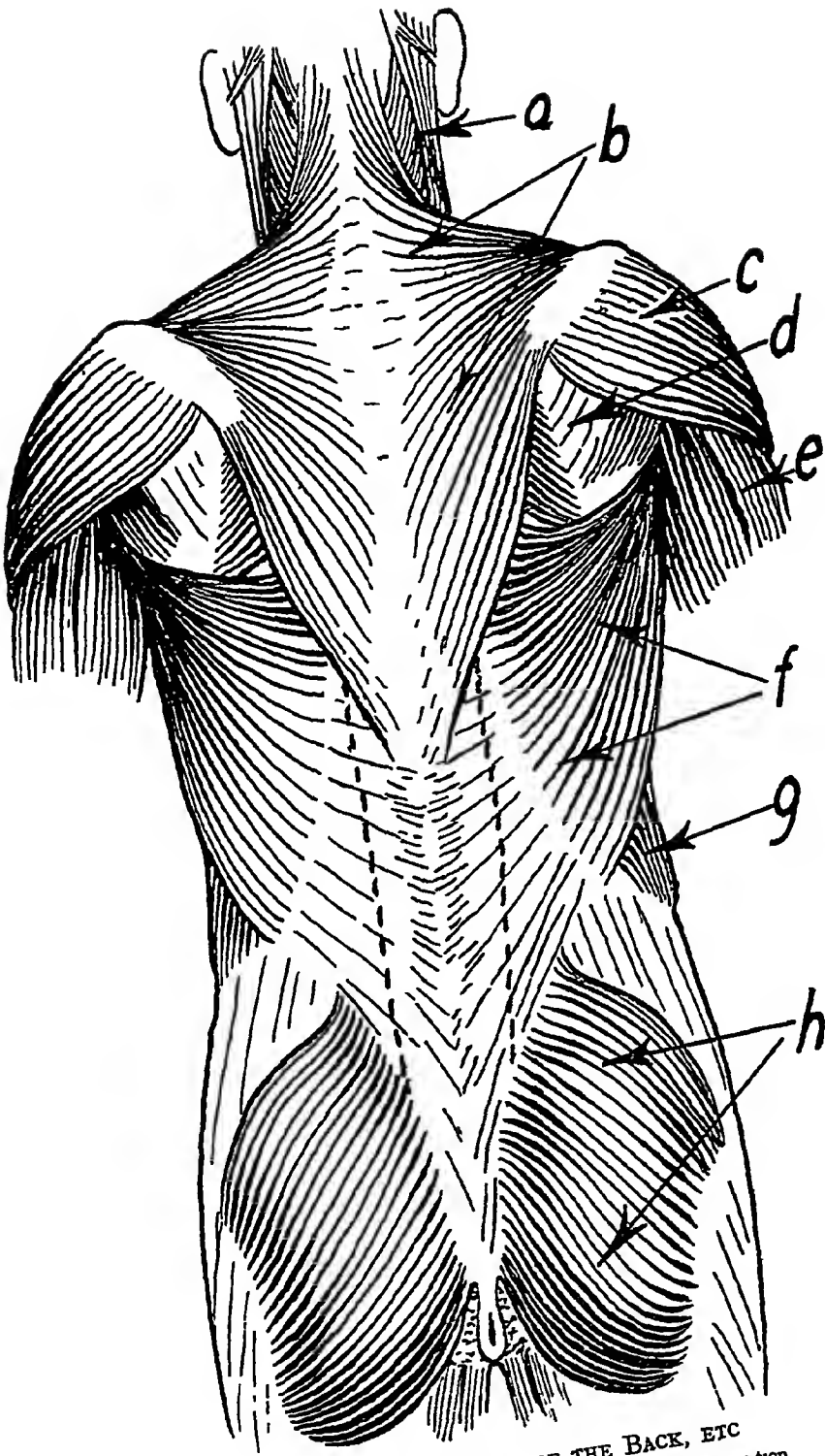


FIG 30—MUSCLES OF THE BACK, ETC  
The space between the dotted lines represents the position  
of the erector spinae muscles which lie deeply.

- a = Sternocleidomastoid muscle
- b = Trapezius muscle
- c = Deltoid muscle
- d = Scapula covered by infra spinatus
- e = Triceps muscle

- f = Latissimus dorsi
- g = Fibres of external oblique muscle of  
abdomen
- h = Gluteus maximus



considerable debate Generally, the external intercostals are regarded as being responsible for inspiration, i.e. raising and

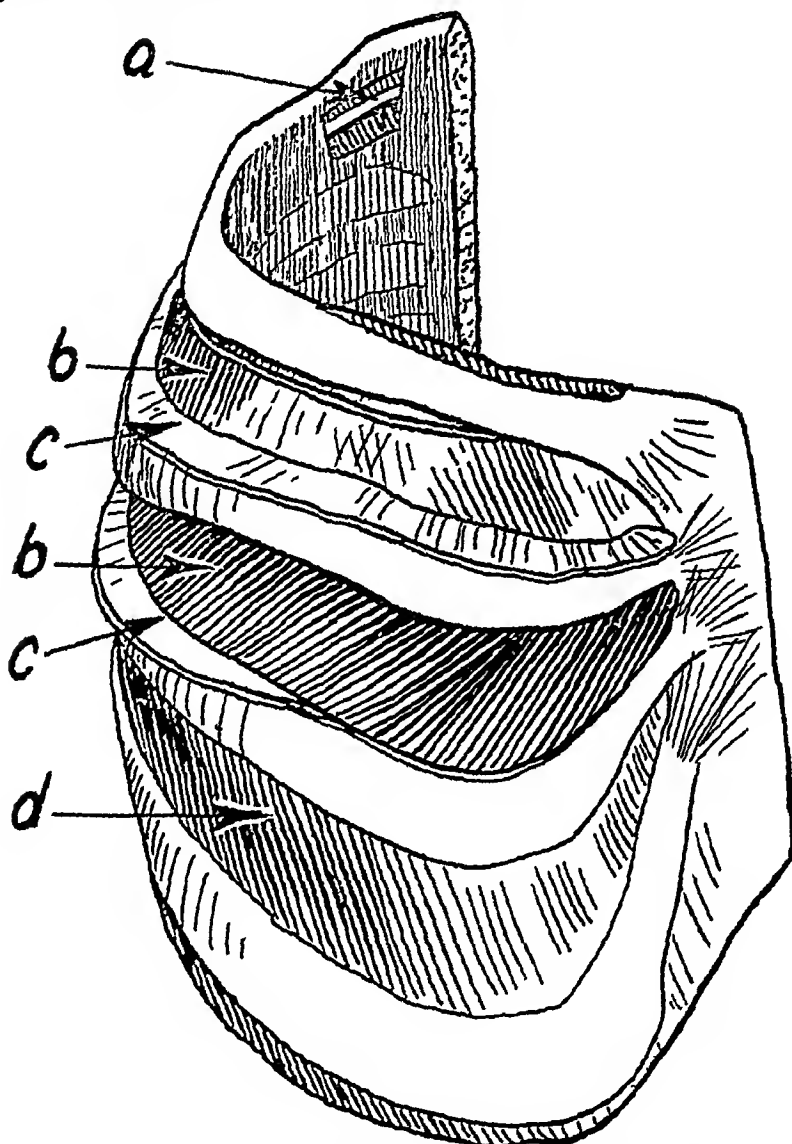


FIG 31 —RIBS WITH INTERCOSTAL MUSCLES

Note the difference in direction of the fibres of the internal and external intercostals

a = Intercostal artery and nerve

b = Internal intercostal muscle

c = External intercostal muscle turned down

d = External intercostal muscle in normal position

expanding the thoracic wall, and the internal for expiration, i.e. contraction and lowering of the thoracic wall

(b) DIAPHRAGM This is a dome-shaped sheet of muscle separating the abdomen from the thorax. It forms, therefore, a partition extending right across the lower part of the thorax. It arises by

groups of muscular fibres from the inner aspect of the lower ribs, from the front of the spinal column and the back of the lower end of the sternum. The fibres pass upwards and inwards to the centre of the dome, which is tendinous. By its contraction it tends to flatten itself out and so to push down the abdominal viscera, which lie immediately beneath it. Actually, as viewed by the X-rays, the movement is largely one of "straightening out" of the sides of the dome, the central point moving only slightly. This has the effect of increasing the capacity of the thorax, and therefore acts as a powerful muscle of inspiration. An expiratory effect through the diaphragm is produced by the strong contraction of the abdominal muscles, which, by forcing the abdominal viscera backwards and upwards, push the diaphragm up and so diminish the thoracic cavity.

The relations of the *Diaphragm* are important. Above, on each side is the base of the corresponding *lung*. Towards the middle, but a little to the left, is the apex of the *heart*. Below, on the left, is the *spleen*. On the right, and reaching across the middle line to the left is the *liver*. Immediately below the liver, towards the left (where this organ is comparatively thin), lies the *stomach*. (See Figs 53 and 55.)

Muscles passing from the thorax to the upper limb (and scapula)

1 PECTORALIS MAJOR. This is a powerful muscle arising from the anterior ends of the upper six or seven ribs, from the outer border of the sternum and from the front of the inner half of the clavicle. This large mass of muscular fibres then passes outwards and converges to form a flattened tendon about 2 in. broad, which is inserted into the front of the upper part of the humerus, in front of the tendon of the *Latissimus Dorsi*. Its lower border forms the anterior fold of the armpit.

*Action*. Its action is to adduct the humerus towards the chest and also to rotate the arm inwards.

2 PECTORALIS MINOR. This muscle is much smaller than the last, and arises from the 3rd, 4th, and 5th ribs, just external to their cartilages, and the fibres pass upwards and outwards to be inserted into the tip of the coracoid process of the scapula. This muscle lies entirely hidden by the Pectoralis Major.

3 SERRATUS MAGNUS. This is a large flat muscle arising from the side of the chest wall, from the upper eight or nine ribs, and the

fibres pass backwards round the chest wall, between it and the scapula, and are inserted into the vertebral or inner border of the scapula

*Actions* The chief action of this muscle is to carry the scapula and so the shoulder and arm forwards

It has one important action that should be remembered, and that is to raise the arm from the horizontal to the vertical position. This is done by the muscles which pass from the scapula to the humerus first fixing these two bones, and then, the serratus magnus, by drawing the lower part of the scapula forwards, rotates the whole shoulder upwards

**SCAPULAR MUSCLES** These are powerful muscles passing from the scapula to the upper part of the shaft of the humerus, and are responsible for the powerful movements of the shoulder joint

**DELTOID** This muscle passes over the top of the shoulder joint from the spine and acromion process of the scapula and the outer third of the clavicle, and is inserted into the outer surface of the humerus, between the upper and middle thirds of that bone. It is an extremely powerful muscle, and gives the rounded appearance to the shoulder joint

*Actions* Abduction of the arm up to, but not beyond, the horizontal position

**SUBSCAPULARIS** This is a powerful muscle arising from the deep surface of the scapula (next to the chest wall), and it is inserted by a tendon about 1 in wide into the lesser tuberosity of the humerus

*Action* Rotation of the humerus inwards

**SUPRASPINATUS** Arises from the posterior aspect of the scapula above the spinous process, and passes outwards to be inserted into the upper part of the greater tuberosity of the humerus

*Action* Abduction of the humerus

**INFRASPINATUS** Arises from the back of the scapula below the spinous process, and passes outwards to be inserted into the greater tuberosity of the humerus just below the supraspinatus

*Action* External rotation of the humerus

Two other muscles, viz the Teres Major and Minor, also arise from the scapula near its lower angle. The teres major is inserted into the humerus in very close proximity to the latissimus dorsi

and the *teres minor* is inserted into the greater tuberosity immediately below the *infraspinatus*. The action of the *teres minor* is the same as that of the *infraspinatus*, and that of the *teres major* is the same as the action of the *latissimus dorsi*.

One very important function performed by the scapular muscles is to afford support to the shoulder joint, and assist in preventing dislocation of the head of the humerus, which they very closely envelop

### Muscles of the Arm.

The muscles of the upper arm are divided into two main groups, viz the extensors and the flexors of the elbow

(1) **EXTENSORS** There is only one main extensor of the elbow joint, and this is the *triceps*. This powerful muscle lies at the back of the humerus, and as its name implies, consists of three main heads, which combine below to form a stout tendon inserted into the *Olecranon Process* of the ulna. The three heads are called the *Long Head*, arising from the lower margin of the glenoid cavity of the scapula, and the *Inner* and *Outer Heads* arising from the posterior surface of the humerus. Between the inner and outer heads of the muscle is a groove in the humerus, called the *Musculo-spiral Groove*, running obliquely round the humerus from behind forwards. In this groove lies the *Musculo-spiral Nerve*, one of the most important nerves of the arm.

*Action of the Triceps* Extension of the elbow joint

(ii) **FLEXOR GROUP** The most important of these is the *Biceps*. This arises by two heads—(1) the long head, which is tendinous, and arises from the upper border of the glenoid cavity of the scapula and passes over the head of the humerus, through the shoulder joint and between the greater and lesser tuberosities of the humerus, and (ii) the short head, which arises from the coracoid process.

There are two other muscles in the front of the upper arm, namely, the *Coraco-brachialis*, which arises from the coracoid process of the scapula, and is inserted into the shaft of the humerus, about half-way down, and the *Brachialis Anticus*, which arises from the lower half of the front of the humerus, and is inserted into the upper end of the ulna in front and immediately below the elbow joint.

*Actions* The biceps and brachialis anticus are the chief muscles of flexion of the elbow. The coraco-brachialis acts on the shoulder joint, and draws the humerus upwards and inwards.

**THE MUSCLES OF THE FOREARM** These are arranged in three main groups, all of which influence the movements of the wrist, hand, and fingers. They are—

(a) *Extensors* (b) *Pronators and Supinators* (c) *Flexors*

(a) *The Extensors* arise from the external condyle of the humerus, and from the posterior aspects of the radius and ulna, and a strong ligamentous sheet (the *Interosseous Membrane*) connecting the shafts of these two bones. These extensor muscles may be divided into two main groups—

(1) Those acting on the wrist, and (2) those acting on the fingers and thumb.

(1) *Extensors of wrist* There are three in this group, two acting on the radial side and one on the ulnar side. Two are called the *Extensor Carpi-radialis Longior* and *Brevior*.

They both arise from the external epicondyle of the humerus, and are inserted into the radial side of the carpus.

The other arises similarly from the external condyle of the humerus, but passes down the ulna side of the forearm, and is inserted into the ulnar side of the back of the carpus. It is called the *Extensor Carpi-ulnaris*.

*Action.* By the combined action of these three muscles the wrist is fully extended.

(2) *Extensors of the fingers and thumb* There is one large muscle, the *Extensor Communis Digitorum*, which arises from the external condyle of the humerus and neighbouring parts, and which divides in the lower third of the back of the forearm into four tendons, which pass beneath a strong band-like ligament stretched over the back of the wrist (*Posterior Annular Ligament*), and after traversing the back of the hand, are inserted into the phalanges of all the fingers.

The tendons passing to the index and little fingers are strengthened by union with tendons from two smaller muscles, the *Extensor Indicis* and the *Extensor Minimi Digiti*.

The tendons so formed, as they pass to their insertion, divide into three slips, the middle one of which is inserted into the base

of the second phalanx, and the two side ones pass on and unite beyond to be inserted into the base of the terminal phalanx. This mode of insertion applies to all the fingers.

*Extensors of the Thumb* These are three in number and arise from the back of the forearm, from the radius and ulna and interosseous membrane, and their tendons are inserted respectively into the base of the metacarpal bone, and the bases of the first and second phalanx.

If the thumb is fully extended a depression can be felt on the radial side of the wrist joint, just above the base of the metacarpal bone of the thumb. In thin individuals this is very well marked and the Extensor tendons of the thumb are responsible for its formation, the tendons of the extensor of the metacarpal bone and first phalanx lying on the outer side and the extensor of the second phalanx lying on the inner side. The names of these muscles are Extensor of the metacarpal = *Extensor Ossis Metacarpi Pollicis*, extensor of the first phalanx = *Extensor Brevis Pollicis*, and the extensor of the second phalanx = *Extensor Longus Pollicis*.

*Actions* All these muscles are simple extensors of the thumb and fingers and wrist. With regard to the extensor of the fingers, it is interesting to note that fibres of one tendon often pass across to the next, so that it is impossible to extend every finger independently unless the other three are held and prevented from extending.

Another important anatomical point to remember is that as the tendons pass over the wrist, they are held in position by the posterior annular ligament, and are provided with sheaths of synovial membrane and fluid, so as to lubricate their passage.

(b) *Pronators and Supinators* These are four in number, not counting the biceps which has a strong supinating action on the radius in addition to its flexor action on the elbow.

(1) *Supinator Brevis* This is a small muscle arising from the upper end of the ulna and passing round the neck of the radius from behind forwards, to be inserted into the outer surface of the upper third of the bone.

*Action* On contraction it rotates the radius outwards, and so supinates the hand (places it in a position palm upwards).

(2) *Pronator Radii Teres* This muscle arises from the internal

condyle of the humerus and passes obliquely downwards and outwards to be inserted into the middle of the radius along its outer border.

*Action.* On contraction it draws the radius over and internally rotates it, carrying the hand into the prone position

(3) *Pronator Quadratus.* This muscle is a broad muscle lying at the lower end of the forearm in front, and passes straight across from the radius to the ulna

*Action* By its contraction it rotates the lower end of the radius over the ulna and so pronates the hand.

(4) *Supinator Longus* This muscle arises from a ridge just above the external condyle of the humerus, and passes downwards to be inserted into the styloid process of the radius. Its *action* is partly pronation and partly supination, and it also acts as a weak flexor of the elbow. When it contracts it places the radius in a position midway between pronation and supination, so that if the radius starts in a position of pronation it partly supinates it, and vice versa

(c) *Flexor Muscles of the Forearm* These muscles, as in the case of the extensors, are divided into two groups, (i) those acting as flexors of the wrist, and (ii) those acting on the fingers.

They arise from the humerus from the internal epicondyle and ridge immediately above this, and also from the anterior surfaces of the radius and ulna and the interosseous membrane. They are inserted by means of tendons into the carpus and the phalanges

*Group (i)* consists of two muscles, namely, one acting as flexor on the radial side of the carpus (*Flexor Carpi-radialis*, inserted into the base of the second metacarpal bone), and one acting on the ulnar side (*Flexor Carpi-ulnaris*, inserted into the pisiform bone of the carpus). A third small muscle (the *Palmaris Longus*) may also be included in this group. It arises with the other flexors and is inserted into the soft parts of the palm of the hand (*Palmar Fascia*) and not into the bone.

*Group (ii).* The flexors of the fingers consist of two composite muscles, one deep and one more superficial. These muscles divide into tendons for insertion into each finger. The more superficial muscle is called the *Flexor Sublimis Digitorum*, and the deep one the *Flexor Profundus Digitorum*. The tendons from these muscles

pass under a strong ligament (the anterior annular ligament) of the wrist, which holds them in position, and in this part of their course they are provided with a synovial sheath, which is common to all the tendons

The arrangement of the tendons is worth noting. The tendons of the flexor sublimis lie in front of those of the flexor profundus as they pass to each finger. Over the base of the first phalanx the tendon divides into two parts, which then pass round the underlying flexor profundus tendon and become united again deep to the latter tendon. The sublimis tendon then passes on to be inserted into the base of the second phalanx, while the tendon of the profundus is inserted into the base of the last phalanx.

#### *The Flexor of the Thumb*

This is called the *Flexor Longus Pollicis*, and arises from the front of the shaft of the radius, and passing under the annular ligament is inserted into the last phalanx of the thumb.

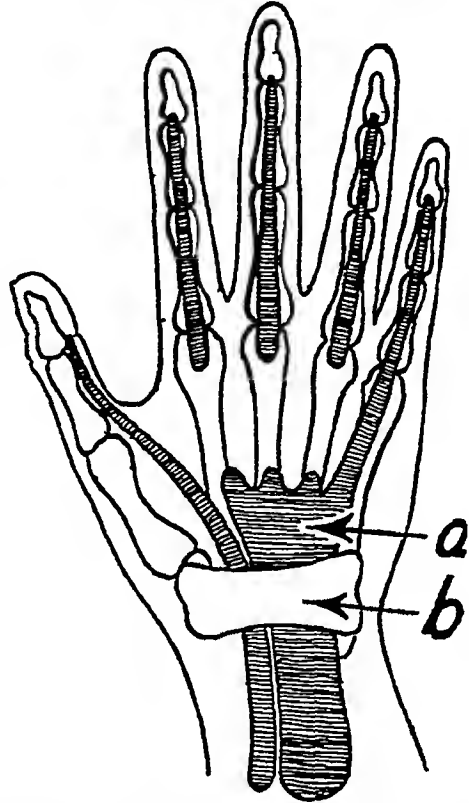


FIG 32—DIAGRAM ILLUSTRATING THE FLEXOR TENDON SHEATHS OF THE HAND

Note that the sheath of the tendon of the thumb is independent and extends up beyond the wrist, and that the sheath of the little finger tendon is the only one in direct communication with the common sheath of the wrist.

*a* = Sheath common to all the tendons at the wrist.  
*b* = Anterior annular ligament of wrist.

**TENDON SHEATHS** The tendon sheaths of the front of the hand are of considerable importance. It will be remembered that the tendons of the flexors of the fingers have a common tendon sheath in front of the wrist. This sheath sends a prolongation downwards for the tendons passing to the little finger, whereas the tendons of the index, ring, and middle fingers have separate sheaths. The sheath of the flexor longus pollicis is distinct from the others, and envelops the tendon of that muscle from the wrist to its insertion.



The importance of remembering the arrangement of these sheaths lies, from a surgical point of view, in the greater likelihood of a deep infection of the little finger spreading upwards to the tendon sheath of the wrist. In the case of the other fingers, the tendon sheaths do not communicate with the main one at the wrist, so this risk is diminished.

**SMALL MUSCLES OF THE HAND** It is not proposed to enter into detail with regard to these. The ball of the thumb consists of a number of small muscles which are responsible for the finer movements of this digit. Other muscles (the *Interossei*), which lie between the metacarpal bones, are inserted into the sides of the first phalanges, and act as adductors and abductors of the fingers.

### Muscles of the Abdomen.

These are divided into two main groups—

- (i) Those forming the abdominal wall, and
- (ii) Those lying within the abdomen in front of the spine.

(i) **THE ANTERIOR ABDOMINAL WALL** This consists of three layers of muscles. These muscles are sheet-like, and their tendons are aponeurotic so as to form continuous tendinous sheets completely enclosing the abdominal contents. The three muscular layers are called the External Oblique, the Internal Oblique, and the Transversalis.

*External Oblique* is the most superficial and arises from the lower eight ribs. The muscle fibres pass downwards and forwards, and become aponeurotic in front. The aponeuroses from the right and left muscles meet and become continuous in the middle line and below are inserted into the crest of the ilium and the pubic bone.

*Internal Oblique* lies immediately beneath the external oblique and arises from the crest of the ilium, and its fibres pass upwards and inwards (crossing those of the external oblique). The muscle is inserted by muscular fibres into the lower four or five ribs, and by an aponeurosis, which meets and becomes continuous with its fellow of the opposite side, in the middle line.

*Transversalis*. This, the deepest of the three layers, arises from the crest of the ilium, from the lower six ribs and from an aponeurosis attached to the lumbar vertebrae. Its origin is thus continuous, and the muscle fibres pass transversely to the front.

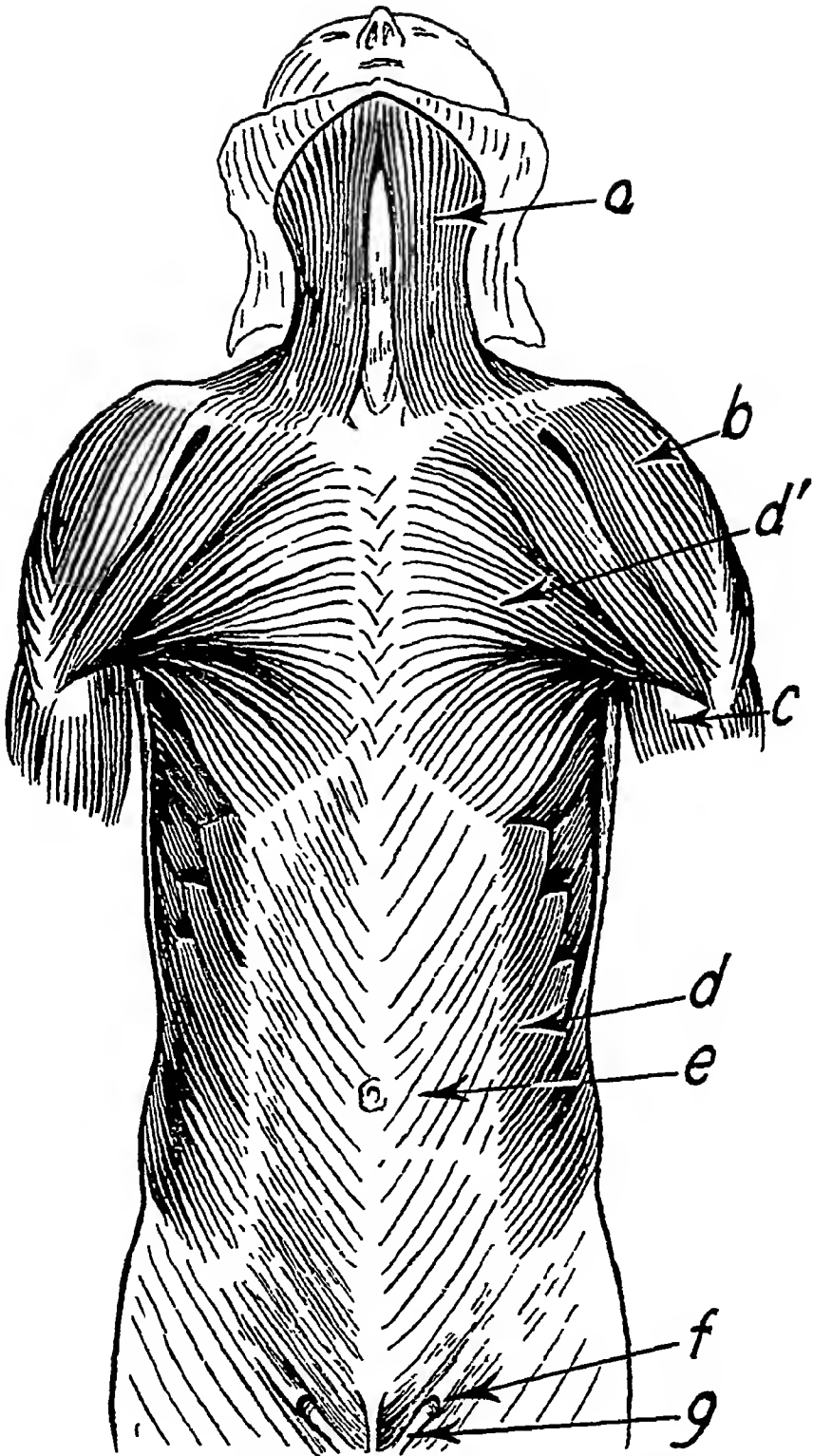


FIG 33 —MUSCLES OF THE FRONT OF THE BODY

a = Platysma  
 b = Deltoid  
 c = Biceps  
 d = External oblique  
 d' = Pectoralis Major

e = Aponeurosis of the external oblique forming the front of the sheath for the rectus abdominis which lies beneath it  
 f = External abdominal ring  
 g = Spermatic cord

of the abdomen, where they end in an aponeurosis which becomes fused with that of the internal oblique

**RECTUS ABDOMINIS** This is a powerful muscle passing straight down the front of the abdominal wall (one on each side of the middle line) It arises from the 5th, 6th, 7th rib cartilages, and is inserted into the crest of the pubic bone The whole muscle is enclosed in a sheath formed by the splitting of the aponeuroses of the oblique muscles of the abdomen as they reach the front of the abdomen

Normally the gap between the two recti muscles is very slight, and is filled by the final fusion of the oblique aponeuroses after these have split to enclose the muscle on each side.

This line of fusion, running all the way down the middle of the abdominal wall, is called the *Linea Alba*

The above description of the abdominal muscles has been simplified as much as possible, but there are some details of the arrangement of the muscles and aponeuroses in the groin which must be described at greater length The region of the groin is one of the weakest in the abdominal wall, the weakness being more marked in the male than in the female This is due to the presence of an opening in the aponeurosis of the muscles for the passage of various structures from within the abdominal cavity. In the female the only structure of importance is a small ligament (the round ligament of the uterus), but in the male the spermatic cord and vessels all pass from within the abdominal cavity into the scrotum, and in their passage pass through the musculature of the abdominal wall

The gap through which these structures pass is called the *Inguinal Canal*, and is 1-2 in long, and placed obliquely so that the lower and inner opening of the canal lies immediately above the pubic spine.

In order to understand the anatomy of this region the reader must remember that the external oblique muscle is inserted into the crest of the ilium and into the pubic bone (*Symphysis*) Between the anterior end of the crest of the ilium and the pubic bone there is, therefore, a free edge of the aponeurosis of the external oblique, and this free lower border is thickened to form a ligament (*Poupart's Ligament*) Immediately above and to the

inner side of the pubic attachment of this ligament is a triangular opening in the external oblique aponeurosis, called the *External Abdominal Ring*. This is the lower and external opening of the inguinal canal. The internal opening is a gap situated below the curved fibres of the internal oblique and transversalis muscles. The fibres of these muscles arch over from the crest of the ilium and the outer third of Poupart's ligament to the pubic symphysis, and the gap below these arching fibres is the internal opening of the inguinal canal, called the *Internal Abdominal Ring*.

In the case of a rupture, it is through this canal that the contents of the rupture pass, and the first step is for the intestine to bulge through the internal ring, then pass downwards towards the external ring, and so out into the scrotum. The internal ring corresponds on the surface of the body to a point about midway between the anterior superior spine of the crest of the ilium and the symphysis pubis.

(11) **MUSCLES WITHIN THE ABDOMEN** It must be appreciated that the muscles of the abdominal wall, mentioned above, are attached behind to the transverse processes of the vertebrae, and therefore the bodies of these bones lie within the abdominal cavity.

There are only two large muscles lying within the abdominal cavity. These are (1) *Psoas*, and (2) the *Iliacus*.

These muscles unite below into one muscular bundle, which passes out from the pelvis under Poupart's Ligament, and is inserted into the lesser trochanter of the femur. Within the abdomen the psoas arises from the side of the bodies and the transverse processes of the lumbar vertebrae, and the fibres pass down into the pelvis. Here they are joined by the fibres of the iliacus, which arise from the inner surface of the iliac bone.

### Muscles of the Lower Limb.

The muscles of the thigh are very powerful and complex in their attachments. It is, therefore, not proposed to do more than give a general indication of their arrangement, mentioning only the more important by name.

They may be divided into (1) an upper group, arising from the pelvic bones and inserted into the upper part of the femur; (ii) an

extensor group, arising chiefly from the femur, and being inserted into the upper part of the tibia and fibula, (iii) a flexor group, arising from the pelvis and femur, and being inserted into the back of the upper end of the tibia and fibula, and (iv) an adductor group, arising from the pelvis, and being inserted into the whole length of the femur

(i) **UPPER GROUP** The chief muscles of this group are the *Glutei* and the *Ilio psoas*

The glutei muscles are three in number, namely, the *Gluteus Maximus*, *Medius*, and *Minimus*. They all arise from the outer surface of the iliac bone, and the gluteus maximus also has an extensive origin from the sacrum. These muscles form the prominence of the buttock, and are inserted in and near the greater trochanter of the femur. They are powerful abductors and rotators of the thigh.

The ilio-psoas has already been described. It is a powerful flexor of the hip.

(ii) **THE EXTENSOR GROUP OF MUSCLES** forms the fleshy part of the front of the thigh, and the main mass is formed by the quadriceps muscle, which is in reality made up of four muscles, namely—

(a) *Rectus Femoris*, arising from the iliac bone.

(b) *The Vastus Externus*, arising from the lower part of the great trochanter and the linea aspera of the femur.

(c) *The Vastus Internus*, arising from the linea aspera.

(d) *Crureus*, arising from the front of the shaft of the femur.

These four large muscles unite below in a powerful tendon attached to the upper border of the patella, and so, by means of a patellar ligament, to the tubercle of the tibia.

Their action is that of extension of the knee joint.

(iii) **FLEXOR GROUP (Hamstrings)** These are three in number, viz. (a) *Biceps*, (b) *Semitendinosus*, and (c) *Semimembranosus*.

(a) *Biceps*, as its name implies, has two heads, arising the one from the tuberosity of the ischium and the other from the back of the femur. The tendon of the muscle is inserted into the head (upper end) of the fibula, and forms the outer hamstring.

(b) *Semitendinosus* arises from the tuberosity of the ischium, and is inserted into the upper part of the inner surface of the tibia.

(c) *Semimembranosus* arises from the tuberosity of the ischium,

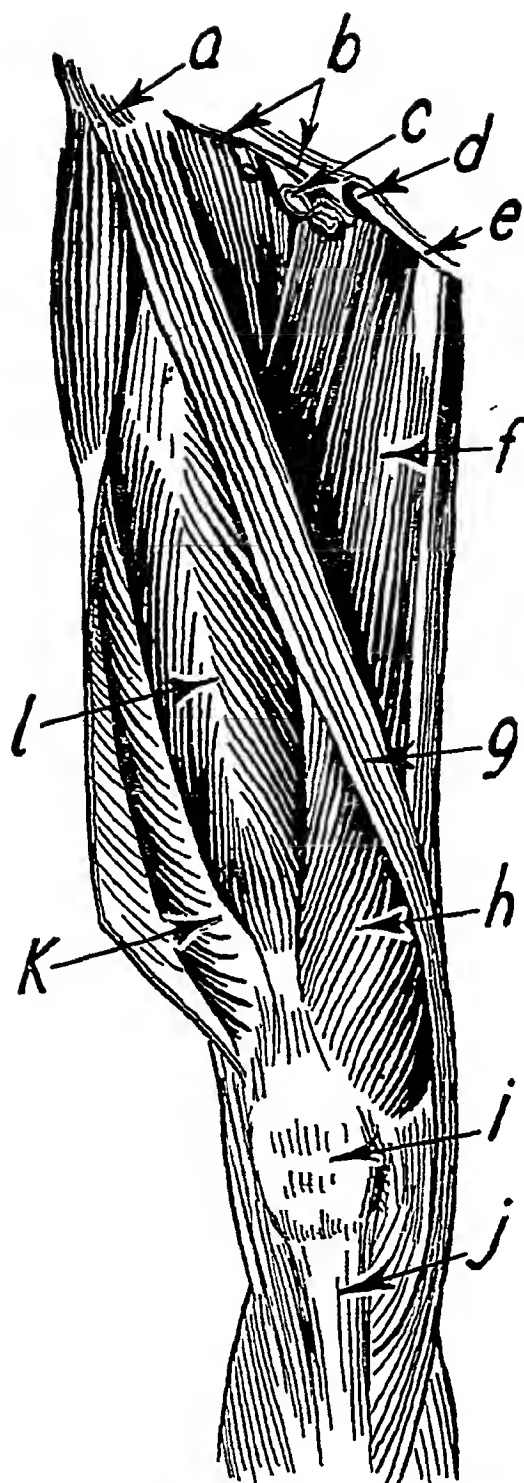


FIG 34—FRONT OF THE THIGH

a = Position of anterior superior spine of the ilium.  
 b = Poupart's ligament (lower margin of the external oblique muscle of the abdomen)  
 c = Femoral vessels emerging from the pelvis and cut short  
 d = External abdominal ring  
 e = Spermatic cord  
 f = Adductor muscles

g = Sartorius muscle  
 h = Vastus internus muscle  
 i = Patella  
 j = Ligamentum patellae  
 k = Vastus externus  
 l = Rectus femoris  
 h, k and l form the quadriceps extensor muscle.

and is inserted into the posterior and inner aspect of the inner tuberosity of the tibia.

The tendons of these last two muscles form the inner hamstrings.

(iv) **ADDUCTORS** This group is situated on the inner side of the thigh and consists of three muscles, the *Adductor Longus*, *Adductor Brevis*, and *Adductor Magnus*. They arise from the pubic and ischial bones, and are inserted into the linea aspera. Their action is to adduct the thigh towards the middle line.

### Muscles of the Leg—Below the Knee.

There are three main groups of muscles arising from the tibia and fibula below the knee, which become tendinous in the lower third of the leg. These tendons pass over the ankle joint, beneath ligaments which hold them in position, and are inserted into the bones of the foot. The names of these three groups are . (i) the *Posterior Tibial Group*, (ii) the *Anterior Tibial Group*, and (iii) the *Peroneal Group*.

In addition to these there is the large calf muscle, called the *Gastrocnemius*.

**GASTROCNEMIUS** This muscle arises by two heads, one from the posterior aspect of each condyle of the femur. The mass of muscular fibres pass down the back of the calf and form the main calf muscle, terminating in the most powerful tendon of the body, the *Tendo Achillis*, which is inserted into the posterior surface of the os calcis.

**POSTERIOR TIBIALS** These lie beneath the gastrocnemius, and arise from the posterior aspect of the tibia and fibula, and the tendons pass downwards behind the internal malleolus, and are inserted into the sole of the foot and the toes. In this group of muscles are found the flexors of the toes, which are inserted into the phalanges of the foot in the same manner as the corresponding tendons of the fingers.

**ANTERIOR TIBIALS** These muscles arise from the anterior aspect of the tibia and fibula, and the tendons pass downwards beneath the anterior annular ligament of the ankle joint, and are inserted into the tarsal bones and the toes. The extensors of the toes are in this group, and are inserted similarly to the corresponding tendons of the fingers.

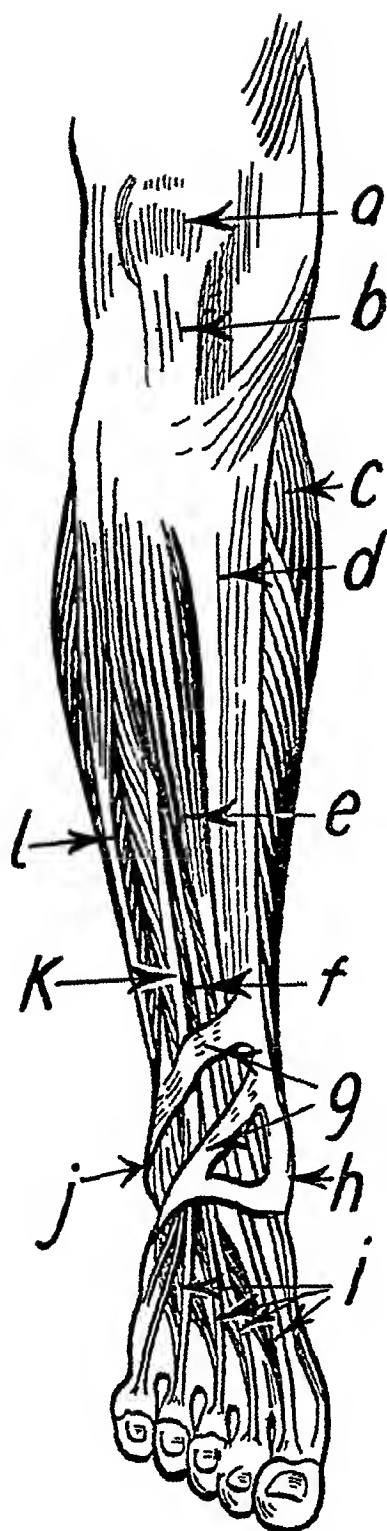


FIG 35—FRONT OF LEG BELOW THE KNEE

a = Patella  
 b = Patella tendon  
 c = Inner head of gastrocnemius  
 d = Tibia  
 e = Tibialis anticus  
 f = Extensor of the great toe

g = Anterior ligament of ankle joint  
 h = Internal malleolus  
 i = Extensor tendons of the toes  
 j = External malleolus  
 k = Extensor communis digitorum  
 l = Peroneus longus



**THE PERONEI** These muscles arise on the outer side of the fibula and, three in number, pass over the ankle joint behind the external malleolus to be inserted into the sole and outer border of the foot. Their action is that of extension of the ankle joint and also eversion of the foot.

As in the hand, so in the foot, there are some small muscles arising from the tarsal and metatarsal bones, and inserted into the phalanges of the toes, but they need not be described in detail.

## CHAPTER VI

### PHYSIOLOGY OF THE MUSCLES

THE essential property of muscle tissue, which differentiates it from almost all other forms of living tissue, is its contractility. The *raison d'être* of every muscle is its contractile power

#### Structure of Muscle.

Every muscle in bulk is made up of innumerable small, long fibres, each of which is, in reality, a specialized cell

These fibres are of two kinds, (1) striped and (ii) unstriped

Every muscle, as a rule, is made up of one or other of these two varieties, and the musculature of the body can, therefore, be divided into these two groups of striped and unstriped muscles. These stripes are not visible to the naked eye, but are seen only by the microscope as transverse markings of light and shade, alternating along the whole length of each fibre

There is a third type of muscle also found in the body, which is in many respects intermediate in its character between striped and unstriped, and that is the Heart Muscle

(1) STRIPED MUSCLE All the voluntary muscles of the body are included in this group. By voluntary is meant all those muscles whose activities can be controlled by the brain. This excludes, therefore, the heart muscle, the muscles of the digestive tract, and other muscles over which the brain has no conscious control

All muscle tissue is elastic, i.e. if put on the stretch it tends to return to its original form. Normally, muscles attached to bones are slightly stretched, and are said to be in a condition of tone, and exert a continuous slight pull on the bones. This property of tone and elasticity serves a very useful purpose, as was explained in the chapter on the Physiology of the Joints. It means that as the muscles of the limbs are arranged in opposing groups—flexors and extensors, abductors and adductors, etc.—whenever one group contracts, it is pulling against the force represented by the tone and

elasticity of the opposing group. This enables joint movements to take place smoothly and without jerking, and it also prevents any sudden violent strain of a joint unless the force is extreme.

*Muscular Contraction* Contraction of a muscle does not take place spontaneously. A stimulus is necessary in order to excite a muscle to contract. This stimulus is normally supplied by the nerves passing to the muscle, whether under the conscious control of the brain or not, but other stimuli are also effective, e.g. a mechanical stimulus by a blow, electrical stimuli, or chemical stimuli. When a contraction takes place, chemical changes occur within the muscle, and the complex organic substances present in the muscle are oxidized into simpler products, of which carbon dioxide (carbonic acid gas) and lactic acid are two of the more important. The chemical changes are accompanied by liberation of heat, and the products of oxidation are eliminated into the blood. In the event of prolonged muscular action, these products cannot be removed quickly enough, and therefore accumulate. Similarly, if sufficient oxygen be not supplied the material will be only partially oxidized, and these intermediate products of oxidation are eliminated with difficulty. This results in a hampering of muscular action presented to consciousness as fatigue, and shown in the muscle by a gradually diminishing power of contraction, the contractions becoming slower and less powerful.

A vast number of experiments on the properties of muscles during contraction have been made by stimulating them when isolated from the body by electrical currents, but these experiments need not be described in detail. Some important points have, however, been demonstrated, which might be mentioned here.

(a) *Latent period* By this is meant the time that elapses between the application of the stimulus and the contraction of the muscle. This varies enormously under different circumstances, but approximately 0.1 sec may be taken as the normal period. The latent period is prolonged by cold, fatigue, and the load on the muscle.

(b) If successive stimuli of equal strength are applied, the contractions at first slightly diminish, but then gradually increase in extent until a maximum is reached.

(c) *Fatigue* If the stimuli in the experiments described in the

last paragraph are continued, the contractions gradually diminish until finally the muscle refuses to respond at all. This is true physiological fatigue, and is usually attributed to the accumulation of the waste chemical products of contraction.

*Energy of Muscular Contraction* When a muscle contracts three forms of energy are liberated, namely. (i) heat, (ii) electrical energy; (iii) work, i.e. external work, such as lifting a weight or overcoming a resistance. These forms of energy are produced by the chemical changes that occur in the muscle during its contraction.

In every muscle, as is well known, a large amount of the explosive energy (cp. in an internal combustion engine) is converted into heat, and only a relatively small proportion (say 25 per cent) can be utilized in external work.

The human muscle has been shown by experiment to correspond very closely in its efficiency to such an engine, and some 25-30 per cent of the actual energy liberated in a contraction may be available for external work.

Another method of investigating muscular contraction is by means of the "Ergograph." This is an instrument by which a weight is attached to a finger, and the individual experimented on flexes or extends the finger regularly, the amount of work thus done by raising the weight being accurately measured. Several interesting facts are found from this form of experiment, viz. (1) Provided sufficient time is allowed to elapse between each contraction (a few seconds with a light weight) no fatigue is noticed. (2) If fatigue is allowed to take place it gradually increases until the muscle is powerless to do any work. (3) Various local and general conditions of nourishment, massage, etc., are found to increase or diminish the power of the muscle and delay or accelerate fatigue. Sugar, for example, has been found to have a marked effect in improving the force of muscular contraction. (4) If, after the muscle is fatigued, further efforts are made to force it to do work, the period of time for complete recovery to take place is very much prolonged.

*Muscular Tone* As has previously been mentioned, all muscles in the human body are normally in a state of tone, and this tone depends on the integrity of the nerve supply of the muscle. If

this is damaged the muscle at once becomes flaccid. This occurs in cases of paralysis, and if one group of muscles is so affected, it is clear that the opposing group which are still in tone will cause stretching of the paralysed group. In this way are paralytic deformities developed.

*Rigor* This term is used to describe the contraction and stiffening of a muscle when it dies. Such a rigor may develop within a very short time after death, namely, a few minutes, or may be delayed to three or four hours. The development of this rigor follows chemical changes occurring in the muscle after its death, associated with the formation of lactic acid.

(ii) **PLAIN MUSCLES** The individual fibres in this type of muscle are very much shorter than in the striped muscle, and have no cross markings. This form of muscle is found in the stomach and alimentary canal (intestines), in the arteries and lungs and elsewhere in the body where involuntary muscular contractions take place.

The general physiology of this form of muscle is similar to that described above for striped muscles, but, generally speaking, the muscular reaction is slower and less powerful in the plain muscle. Plain muscle is innervated, as is striped muscle, and its tone depends on the integrity of its nervous connections, but the nerves do not belong to the Central or Voluntary nervous system, but to the Sympathetic or Involuntary nervous system (see Chapter VII), and are, therefore, only indirectly connected with the brain.

(iii) **CARDIAC MUSCLE** The muscle of the heart is unique, and is in many respects intermediate in character between the two preceding forms. The individual fibres are faintly striated, and are very short, giving the appearance under the microscope of a quadrilateral shape with a short prolongation at one angle. The characteristic feature of heart muscle is its power of rhythmic contraction. Another striking characteristic is that the strength of the contraction does not vary with the stimulus. Provided the stimulus is sufficient to cause a contraction, the contraction will be maximal.

## CHAPTER VII

### ANATOMY OF THE NERVOUS SYSTEM

THERE are two main nervous systems of the body, namely, the Central Nervous System, and the Sympathetic System. Briefly, the difference between the two is that the Central Nervous System controls the conscious life of the individual, and the Sympathetic System the unconscious, or involuntary, mechanism.

Every nerve fibre consists of a specialized cell, angular in shape, and with small fibres arising from the angles. From one angle the main fibre arises and passes on to its destination in skin or muscle. Each nerve is made up entirely of these fibres, the cells being situated either in the brain or spinal cord in the case of the Central Nervous System, or in special collections, called *Ganglia*, in the case of the Sympathetic System.

### CENTRAL NERVOUS SYSTEM

This consists of the Brain, Spinal Cord, and nerves arising directly from these. All the nerves of this system are connected directly either with the spinal cord or with the brain.

#### Brain.

Weight, about 49 oz. This is divided into four parts—

- (i) the Cerebrum,
- (ii) the Cerebellum,
- (iii) the Medulla Oblongata,
- (iv) Pons Varoli.

The cerebrum fills the main part of the cranial cavity, the cerebellum lies behind and beneath it (in close contact with the lower part of the occipital bone), and the medulla oblongata is the connecting link between the cerebrum, cerebellum, and spinal cord, and consists largely of nerve fibres passing from the cerebrum to the spinal cord. It lies immediately above the foramen magnum within the skull.

(1) **THE CEREBRUM** This forms the major portion of the brain, and is divided into two lobes or hemispheres, right and left, with a deep sulcus running longitudinally between them

The surface of these cerebral lobes is marked by a large number of irregular fissures, and the intervening brain subdivisions are called convolutions Though there are a very large number of

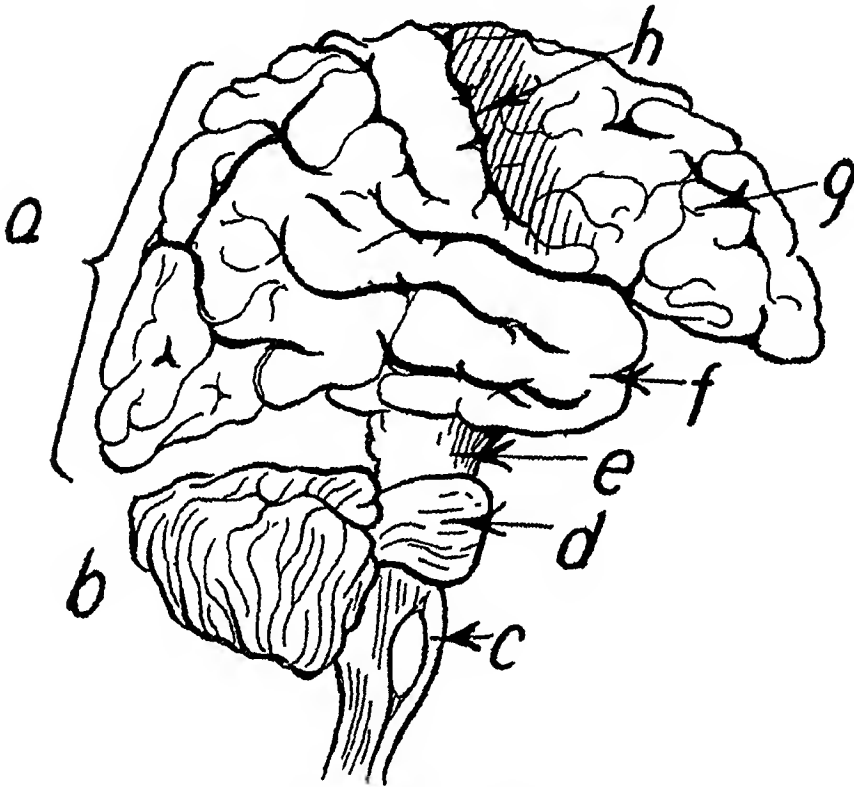


FIG 36 —BRAIN (SIDE VIEW)

The shaded area is the "motor area"

a = Cerebrum  
b = Cerebellum  
c = Medulla oblongata  
d = Pons varoli

e = Crura cerebri  
f = Temporal lobe  
g = Frontal lobe  
h = Fissure of Rolando

these convolutions, they are very constant in their arrangement, and most of them are named There is no need to describe these convolutions in detail, but the reader should understand that the function of each is very definite, and in many cases is accurately known The most important convolutions are those lying immediately in front of and behind a large fissure which runs obliquely downwards and forwards, across the side of the cerebral hemisphere, about half-way between the back and the front of the lobe This fissure is called the *Fissure of Rolando*, and separates two

convolutions, the one lying in front of the fissure being that in which all the voluntary impulses to the limbs and trunk muscles arise. The convolution lying immediately behind the fissure of Rolando is that which receives the main sensory impressions from the body. It is important to remember this anatomical position of the motor area, particularly as skull injuries in this region may affect this part of the brain and cause varying degrees of paralysis.

Apart from the anatomical subdivision into convolutions, the surface of the brain is also divided into regions named after the part of the skull beneath which they lie, namely, the frontal lobe, parietal lobe, occipital lobe, and temporal lobe.

*Grey and White Matter* If the cerebral lobes be cut across, two well marked portions are clearly defined, namely, a superficial greyish stratum lying close to the surface, consisting, microscopically, of the nerve cells of the brain, and beneath this layer the remainder of the brain is of a whitish colour, and is composed of the nerve fibres arising from the grey layer and passing down to the spinal cord.

These two portions are called the Grey Matter and the White Matter of the brain respectively.

(ii) **THE CEREBELLUM** This is a relatively small portion of the brain, lying immediately below the back part of the cerebrum (the occipital lobes), and is about  $3\frac{1}{2}$  in across and about 2 in deep. Like the cerebrum, it is divided into two lobes. Its surface is covered by a very large number of small sulci (deep grooves).

(iii) **THE MEDULLA OBLONGATA** This may be regarded as the "stalk" of the brain, and consists of motor nerve fibres passing downwards into the spinal cord, and of other fibres (sensory) passing up to the brain from the spinal cord. It acts, therefore, as a connecting link between the spinal cord and the cerebrum and cerebellum.

Above it is continuous with the lower part of the cerebrum, and the cerebellum lies immediately behind it.

(iv) **PONS VAROLII** This is a strap-like bundle of nerve fibres, passing across the front of the medulla and communicating behind with the cerebellum.

**COVERINGS OF THE BRAIN (MENINGES)** There are three membranes covering the brain, namely, the Dura Mater, Arachnoid and



**Pia Mater** These are fibrous in structure and are arranged as follows—

*The Dura Mater* is the firmest of the membranes and lines the skull, being divided into two layers, one of which is incorporated with the periosteum on the inner surface of the skull, and the second layer lies immediately between this and the brain. These two layers are in close apposition, but are separated in certain directions to form channels for the conveying of venous blood, these channels forming the main veins draining blood from the brain and skull.

The inner layer of the *Dura Mater* is reduplicated so as to pass down between the hemispheres of the cerebrum and between the cerebrum and the cerebellum. It is between these reduplicated layers that the main venous channels lie.

*The Arachnoid* is a loose cellular layer, lying between the *Dura Mater* and the *Pia Mater*.

*The Pia Mater* is a very fine membrane covering closely the surface of the brain, and passing down into the main sulci.

All these coverings are continued down the spinal cord, and prolongations of them are continued outwards for a very short distance along the course of the nerves as they emerge from the spinal cord.

## Spinal Cord.

The spinal cord runs the whole length of the spinal column, as far as the lower border of the first lumbar vertebra. Like the brain, it consists of both grey and white matter, but the white matter is to the outside and the grey matter towards the centre and front of the cord. The white matter consists of nerve fibres, some passing down the spinal cord from the brain and terminating in close contact with the nerve cells of the grey matter in the spinal cord, and others passing up to the brain from the sensory fibres. The grey matter consists of cells from which originate a second relay of nerve fibres which pass down the spinal cord for a short distance and then pass out as motor nerves to supply the muscles of the body. These nerves arise in pairs, one on each side of the spinal cord, and emerge from the spinal column between contiguous vertebrae. There are thus, 8 cervical pairs, 12 dorsal, 5 lumbar, 5 sacral, and 1 coccygeal.

Each spinal nerve is a mixed nerve, i.e. contains both sensory

and motor fibres. As mentioned above, the motor fibres arise from the cells within the spinal cord, and these fibres pass out towards the front of the cord. The sensory fibres, on the other hand, pass into the spinal cord towards the back, and so each spinal nerve has anatomically two roots, an anterior or motor root, and a posterior or sensory root. Each sensory root has a thickening on it, called the *Root Ganglion*, and this consists of nerve cells which send out two processes, one towards the periphery and one towards the spinal cord. This is, therefore, the origin of the sensory nerve fibres.

As the nerves leave the spinal cord, they frequently send small branches to communicate with the neighbouring nerves, and in certain parts these communications are so large and complicated that they are given specific names. The network of nerves formed by these inter-communicating fibres is called a "Plexus," and there are four of these, namely, the *Cervical Plexus*, formed by the connections between the 1st, 2nd, 3rd, and 4th cervical nerves, a *Brachial Plexus*, formed from the 5th, 6th, 7th, and 8th cervical and 1st dorsal nerves, a *Lumbar Plexus* from the 1st, 2nd, 3rd, and 4th lumbar nerves, and a *Sacral Plexus* from the 5th lumbar and 1st, 2nd, and 3rd sacral nerves. By the rearrangement of the nerve fibres that take place in these plexuses, main nerves are formed which pass in the case of the cervical plexus to the muscles of the

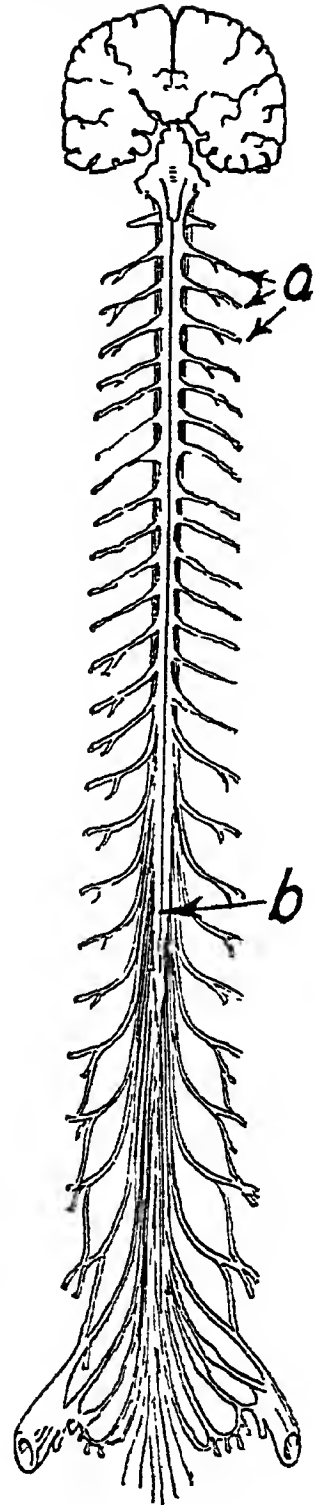


FIG 37—BRAIN AND SPINAL CORD

a = Peripheral nerves arising from the spinal cord  
b = The cauda equina.

neck, the brachial plexus to the muscles of the arms, the lumbar plexus to the muscles of the pelvis and thigh, and the sacral plexus to the muscles of the legs

The most important of these plexuses is the *Brachial Plexus*, for two reasons, one, that it supplies the upper limbs and, secondly, because it is more exposed to injury than the other plexuses. It lies at the root of the neck, and the interchange of fibres takes place almost from their origin in the spinal cord, until they reach the axilla. The only real protection these nerves have is from the

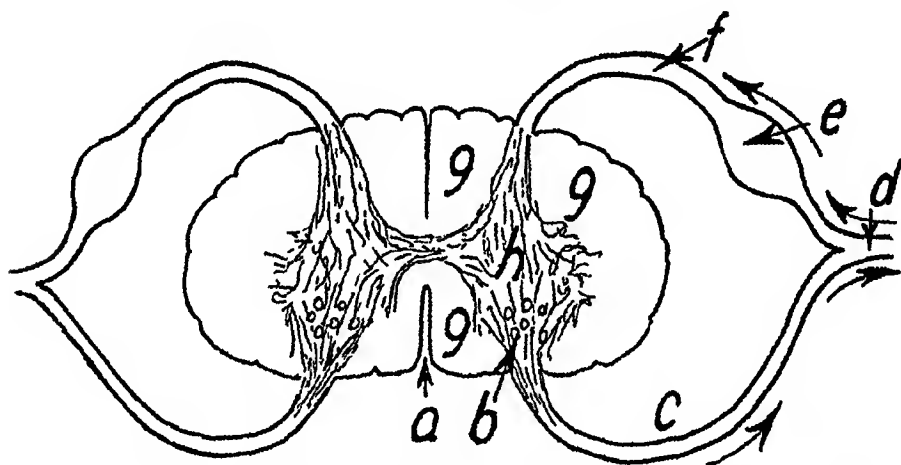


FIG 38—SECTION OF THE SPINAL CORD SHOWING DIAGRAMMATICALLY THE ROOTS OF A SPINAL NERVE

The unlettered arrows represent the direction of the nerve impulses

- |                                    |   |
|------------------------------------|---|
| a = Anterior fissure               | e = Posterior nerve root ganglion (sensory) |
| b = Nerve cells from which arise c | f = Posterior nerve root (sensory)          |
| c = Anterior nerve root (motor)    | g = "White matter," i.e. nerve fibres       |
| d = Mixed nerve                    | h = "Grey matter," i.e. nerve cells         |

clavicle, which lies in front of them, and the sternomastoid and trapezius muscles. It is, however, a not infrequent event for the nerves to be damaged either by a direct blow or by injury from a fractured clavicle or by overstretching, as for example when a heavy weight falls on the side of the neck, forcing the shoulder down and the head over to the other side.

### Main Nerves of the Body.

**CRANIAL NERVES** These are nerves arising in pairs directly from the brain and passing to their destination through various apertures in the skull. They are twelve in number, and are designated either by a number, corresponding to the order in which they arise from the brain, or by name. They are as follows—

1 *Olfactory*, supplying the nose and conducting the sense of smell

2 *Optic*, passing to the eye and conducting the sense of sight

3 *Oculo-motor*, supplying all the muscles moving the eyeball, except two (See 4 and 6)

4 *Trochlear*, supplies the superior oblique muscle of the eye

5 *Trigeminal*, the most important sensory nerve of the face, and motor nerve of mastication

6 *Abducens*, supplies the external rectus muscle of the eye

7 *Facial*, chiefly motor to the muscles of the face

8 *Auditory*, supplying the ear and conveying the sense of hearing

9 *Glosso-pharyngeal*, chiefly sensory to the mucous membrane of the tongue and pharynx

10 *Pneumo-gastric*, supplying the larynx with motor and sensory nerves and the pharynx, oesophagus, stomach and heart with motor fibres

11 *Spinal Accessory* Motor supply of the Sternomastoid and Trapezius muscles

12 *Hypoglossal* Motor nerve to the tongue

Of these the most important are the 2nd, 3rd, 5th, 7th, 8th, 10th, and 11th

*Optic Nerve* Arises on each side from the base of the brain and the nerves from the two sides meet in the middle line on the under surface of the brain, and there join, forming what is known as the Optic Chiasma. They then separate again and pass out of the skull into the orbit where they end in the retina of the eye. At the chiasma most of the fibres cross over to the other side, but some are continued forwards to the eye on the same side as their origin. The right eye is therefore supplied chiefly from the left side of the brain and vice versa.

*Oculomotor Nerve* Arises from the base of the brain and has a long course within the skull, passing forwards to enter the orbit where it supplies the internal rectus, superior rectus, inferior rectus, and inferior oblique muscles of the eyeball. It also supplies the circular muscles of the iris.

*Trigeminal Nerve* This is a very large nerve and divides into three main branches—

1 *The Ophthalmic Division*, which supplies sensory fibres to the

eye (Cornea, Conjunctiva), skin of the eyebrow, forehead, and nose  
It also supplies the lachrymal gland

2 *The Superior Maxillary* This branch passes forwards through the superior maxilla, immediately below the floor of the orbit  
Its chief distribution is sensory to the teeth of the upper jaw, and the skin of the nose, lower eyelid, and upper lip

3 *The Inferior Maxillary* This passes downwards out of the skull, just by the inner side of the *Temporo-mandibular Joint* It then divides into sensory branches supplying the cheek, tongue, and teeth of the lower jaw

All these branches arise from a very large ganglion of nerve cells which is found on that part of the nerve immediately within the skull This ganglion is called the *Gasserian Ganglion*

*Facial Nerve* The importance of this nerve lies in its distribution, as all the muscles of the facial expression are supplied by it, and also on account of its tortuous course through the base of the skull As it passes through, it is very closely related to the middle ear, and in cases of fractured skull this nerve is frequently damaged, it may also be affected by inflammatory conditions of the middle ear

*Auditory Nerve* This nerve supplying the ear has a short course, but it lies during most of it within the petrous portion of the temporal bone, and is closely related to the facial nerve It is frequently damaged in cases of fractured skull

*Pneumogastric Nerve* This is a very important nerve, and has an extensive distribution outside the skull, supplying as it does, the larynx, pharynx, oesophagus, stomach, and heart Its branches supply the muscles of the larynx and the vocal cords, and so the voice Other branches play an important part in controlling the action of the heart and stomach

*Spinal Accessory.* The importance of this nerve lies in its distribution to the sternomastoid and trapezius muscles Surgically it is of great importance, as it has a long course in the neck and may easily be injured during operations on the neck If this accident does occur, the result is very serious, owing to the paralysis of the powerful muscles which it supplies

**NERVES OF THE UPPER LIMB** These are all derived from the brachial plexus The final re-arrangement of the nerves forming

the brachial plexus takes place in the axilla and the main nerves of the arm therefore arise from the brachial plexus in the armpit. No other cross connections of any importance occur after the nerves leave the armpit. The large nerves from the plexus pass down the upper arm and into the forearm and hand, but in the armpit itself some smaller nerves arise for the supply of the scapula and shoulder muscles.

The chief of these axillary branches are—

1 *Circumflex Nerve*, which passes round the neck of the humerus and supplies the deltoid muscle. This nerve is sometimes injured in fractures of the neck of the humerus, and in this event the patient is unable to raise the arm from the side.

2 *Subscapular Nerves*. There are three of these distributed to the subscapularis, teres major, and latissimus dorsi.

3 *Anterior Thoracic Nerves*. Two in number which supply the pectoralis major and minor.

MAIN NERVES OF THE UPPER ARM, FOREARM AND HAND—

- |                      |                              |
|----------------------|------------------------------|
| 1. Musculo-cutaneous | 4. Ulnar                     |
| 2. Median            | 5. Internal Cutaneous        |
| 3. Musculo-spiral    | 6. Lesser Internal Cutaneous |

Of these 1, 2, 3, and 4 are the most important, as they are both motor and sensory in their distribution, 5 and 6 being purely sensory.

1 *Musculo-cutaneous*, is motor to the upper arm, supplying the biceps, coraco-brachialis, and the brachialis anticus. Its cutaneous branch appears on the outer side of the biceps tendon at its insertion into the radius, and divides into two branches which supply the anterior and posterior surfaces of the radial side of the forearm.

2 *Median*. This nerve is one of the largest of the arm, and lies close to the brachial artery down the upper arm, but gives off no branches until it reaches the forearm, where it supplies the pronator radii teres, pronator quadratus, and all the flexor muscles of the fingers and wrist except the flexor carpi-ulnaris. In the hand it supplies three of the small muscles of the thumb, the remainder being supplied by the ulnar nerve. Its cutaneous branches supply the skin over the front and sides of the thumb, index, and middle fingers, and over the outer half of the ring finger.

3 *Musculo-spiral*. This is one of the most important nerves of

the arm, owing to the importance of the muscles supplied by it and the frequency with which it is injured. This liability to injury

is due to two causes, namely (1) that it lies superficially in the axilla at its origin and is therefore liable to pressure from the use of crutches. This is the cause of so-called "Crutch-paralysis," and (2) that it winds round the shaft of the humerus in a spiral manner, lying quite close to the bone, and so being extremely liable to be injured if this bone is fractured.

It supplies the triceps, supinator longus, brachialis anticus, and extensor carpi-radialis longior. In the forearm it gives off an important branch called the *Posterior Interosseous*, which supplies all the muscles on the back of the forearm, i.e. the extensors of the fingers. Its cutaneous supply is extensive. It supplies the skin over the outer and back part of the upper arm and forearm by two branches called the upper and lower cutaneous branches.

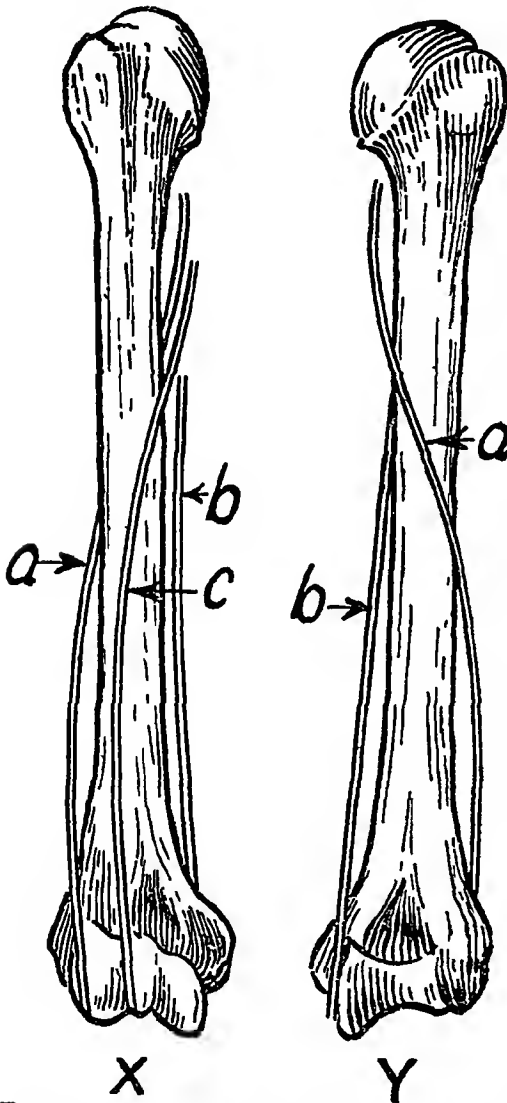


FIG 39—DIAGRAM SHOWING RELATIVE POSITIONS OF THE MAIN NERVES OF THE UPPER ARM

a = Musculo spiral  
b = Ulnar  
c = Median

X = Front view Y = Back view

In the forearm it gives off the radial nerve which is distributed to the skin of the back of the hand and fingers. The distribution to the fingers is important. It supplies the skin on the ulnar side of the thumb, the whole of the skin on the back of the index and

middle fingers, and the radial half of the skin of the back of the ring finger

4 *Ulnar* This nerve lies along the inner side of the upper arm, and gives no branches until it reaches the forearm, where it supplies the flexor carpi-ulnaris and the inner half of the flexor profundus digitorum, the rest of this muscle being supplied by the median

In the hand the ulnar nerve supplies all the small muscles except two or three of those of the thumb, which are supplied by the median

The cutaneous supply of the nerve is to the front and back of the little finger, and the ulnar half of the ring finger

NERVES OF THE TRUNK *Thorax* The wall of the thorax is supplied by the spinal nerves which pass round in between the ribs, lying between the internal and external intercostal muscles. They are called the *Intercostal Nerves*, and, as well as supplying motor fibres to these muscles, they also supply sensory branches to the skin overlying them and to the *Pleura* (lining of the chest wall)

The lower four or five intercostals are continued into the musculature of the abdominal wall. They supply motor fibres to the abdominal muscles and cutaneous branches to the skin

NERVES OF THE LOWER LIMB These are derived from the Lumbar and Sacral Plexuses, which are situated within and immediately above the pelvis. The main branches of the Lumbar Plexus are—

1 *Ilio-hypogastric*. Cutaneous to the skin of the buttock and groin

2 *Ilio-inguinal* Cutaneous to upper and inner part of thigh, and to the genitals

3 *Genito-crural* Motor to the *Cremaster Muscle* (muscle of retraction of the testicle) Cutaneous to upper half of front of the thigh

4 *External Cutaneous* Cutaneous to outer surface of thigh as far as the knee

5 *Anterior-crural* Motor to quadriceps extensor Cutaneous to front and inner side of thigh and inner side of leg to ball of the great toe

6 *Obturator* Motor to the adductors

Of these the fifth and sixth are the most important

The *Anterior-crural* is a large nerve divided into an anterior



and posterior branch. The anterior branch supplies the skin of the front and inner side of the thigh. The posterior branch supplies the skin on the inner side of the leg and the foot as far as the ball of the great toe, by means of a branch called the *Long Saphenous*. The posterior branch also supplies the motor fibres to the quadriceps extensor muscles.

#### BRANCHES OF THE SACRAL PLEXUS—

- 1 *Gluteal* (Superior and Inferior) Motor to the gluteal muscles
- 2 *Small Muscular Branches* to deep muscles near the hip joint
- 3 *Great Sciatic* Cutaneous to most of the skin of the leg, and motor to the back of the thigh and all muscles below the knee
- 4 *Small Sciatic* Cutaneous to the back of the thigh
- 5 *Pudic* Supply the skin of the buttock and the anus, motor to the anal sphincter

*The Great Sciatic Nerve* is the largest nerve in the body. It emerges from the pelvis through the great sacro-sciatic foramen. It passes between the great trochanter of the femur and the tuberosity of the ischium and continues vertically down the back of the thigh until it reaches the lower third, when it divides into two main branches, the *Internal* and *External Popliteal*. In this part of its course the nerve gives motor branches to the biceps, semimembranosus, and semitendinosus, and to the adductor magnus.

*The Internal Popliteal Branch* continues straight down immediately behind the knee joint, in the middle line, and just below the knee passes deep to the gastrocnemius muscle. It then receives the name of *Posterior Tibial*. The Internal Popliteal supplies the gastrocnemius and soleus muscles of the calf.

*The External Popliteal Branch* passes obliquely outwards to the head of the fibula and winds round the outer side of the neck of this bone, and penetrates the peroneal muscles. There it divides into two branches, the *Anterior Tibial* and *Musculo-cutaneous*.

*Posterior Tibial Nerve* This continuation of the internal popliteal passes down the calf of the leg deep to the gastrocnemius to the space between the internal malleolus and the heel, where it divides into the *Internal* and *External Plantar* which supply the muscles and skin of the sole of the foot.

The posterior tibial supplies the calf muscles (*Soleus*, *Flexor Longus Digitorum*, *Flexor Longus Hallucis*, and *Tibialis Posticus*).

The internal and external plantar nerves supply the small muscles of the sole of the foot and the skin of the plantar aspects of the toes

*Anterior Tibial Nerve* This nerve starts at the head of the fibula and passes downwards to the space between the internal and external malleoli, where it divides into two terminal branches which supply the small muscles of the dorsum of the foot and the skin of the adjacent margins of the great and second toes. In its course down the leg it supplies motor fibres to the extensor longus digitorum, tibialis anticus, extensor hallucis, and the smallest peroneal muscle

*Musculo-cutaneous Nerve* This nerve passes down among the muscles on the outer side of the leg (*the Peronei*) and supplies motor fibres to these. When it reaches the ankle joint it divides into two branches which are the cutaneous supply of the inner border of the great toe and the contiguous borders of the 2nd and 3rd, 3rd and 4th, and 4th and 5th toes

The outer surface of the little toe is supplied by the external *Saphenous Nerve*, which is a small nerve formed by branches from the internal and external popliteal and is entirely cutaneous in its distribution

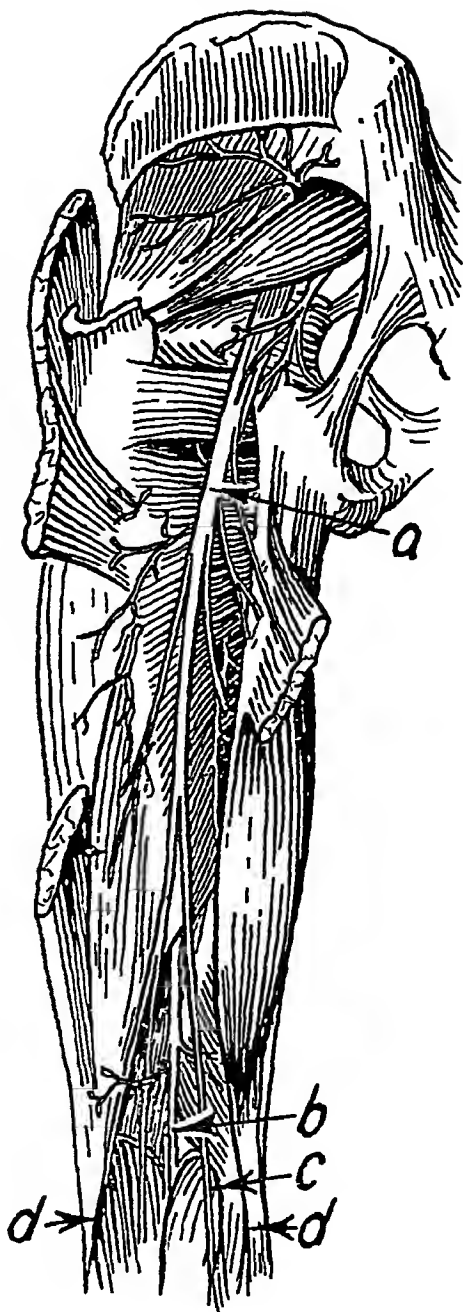


FIG 40—DIAGRAM SHOWING THE MAIN NERVES AND MUSCLES OF THE BACK OF THE THIGH

a = Sciatic nerve      c = Internal popliteal nerve  
b = Popliteal artery      d = Hamstring tendons

## SYMPATHETIC SYSTEM

This is a system of nerves and ganglia (collection of nerve cells) concerned solely with the involuntary activities of the body. These nerves supply the viscera and blood vessels.

The nerves arise from the nerve cells in the ganglia, and these are arranged in pairs down the side of the bodies of the vertebrae.

The fibres arising from the cells of these ganglia communicate with the neighbouring ganglia of both the same and the opposite sides, and in this way a complete network of sympathetic nerve fibres is formed, extending from the brain above to the lowest part of the spine. Other communicating branches pass from the ganglia to the spinal nerves as they emerge from the spinal canal, and so a connection is established between the Sympathetic and Central Nervous Systems.

*The Sympathetic Ganglia* vary enormously in size and in certain places are collected together, and with their inter-communicating fibres form large plexuses. The three main plexuses so formed are called the *Cardiac*, *Solar* or epigastric, and *Hypogastric* plexuses, and are situated in the thoracic, abdominal, and pelvic regions respectively. They are closely related to the main arterial vessel, the *Aorta*, and with all the main branches of the aorta are found smaller subsidiary plexuses which supply nerve fibres to accompany the vessels.

In addition to these branches to the blood vessels, the main plexuses mentioned above supply innumerable branches to the neighbouring viscera, e.g. lungs and heart in the thorax, intestinal canal, liver, etc., in the abdomen, and bladder and generative organs in the pelvis.

## CHAPTER VIII

### PHYSIOLOGY OF THE NERVOUS SYSTEM

THE Physiology of the Nervous System can be studied under two main headings, viz —

- 1 The Central Nervous System
- 2 The Sympathetic Nervous System

### CENTRAL NERVOUS SYSTEM

The functions of the Central Nervous System are many and complicated. The brain is the centre of the system, and to it and from it nerve impulses are continuously arising and departing. The incoming impulses are sensory or “afferent,” and the outgoing ones are motor or “efferent.”

These two nerve impulses are co-ordinated in the brain so that the efferent impulse sent out is appropriate to the afferent impulse. Consciousness is not necessary for this, as can easily be shown by sleep walkers, who can perform the most complicated mechanical movements, and apparently “purposeful,” i.e. with a definite intelligent motive, and yet consciousness may be completely suspended during the whole performance. At the same time, it must be realized that actions performed under such circumstances are almost invariably those of habit, and should any abnormal stimulus be met, i.e. if the normal path of the habit impulses be interrupted, consciousness returns and takes control.

This conscious control of the brain is, therefore, the highest and most important function, and depends upon the powers of reasoning. These higher intellectual functions are generally regarded as being performed by the fore and upper parts of the brain (i.e. the frontal convolutions). It is here that the afferent impulses are analysed and criticized, and the appropriate action to deal with these impulses decided upon and put into execution by efferent impulses to the appropriate motor centres in the brain.

These motor centres lie, as was mentioned in the preceding chapter, just in front of the Fissure of Rolando, between it and the

anterior part of the brain just dealt with. Direct experiment has shown that this part of the brain, or motor area, as it is called, sends direct impulses to the muscles of the trunk and limbs, but of the opposite side. The right motor area in the brain therefore causes movements of the left side of the body, and vice versa. This cross-action is the result of the crossing of the fibres arising from the cortex of the brain as they pass down through the medulla and spinal cord. In cases of apoplexy, where a haemorrhage occurs owing to rupture of a cerebral artery, paralysis of the limbs occurs if the motor area is damaged, and this paralysis is on the left side in a haemorrhage on the right side of the brain, and vice versa.

Immediately behind the Fissure of Rolando is the area of the brain to which afferent impulses are sent (the *Sensory Area*), and the close connection of this area with the Motor Area enables rapid motor response to take place. All these centres are those concerned chiefly with actions and reactions which are usually associated with consciousness. Those centres which have to deal with the purely involuntary but most vital activities, such as the heart beat and respiratory movements, are situated in a lower part of the brain, the medulla.

It will be remembered that the peripheral nerves, i.e. the nerves as they emerge from the spinal cord, have two roots, an anterior and a posterior. The posterior root is composed solely of afferent, i.e. sensory, nerve fibres, and the anterior root solely of efferent, i.e. motor, nerve fibres.

After the union of the two roots to form the mixed nerve, these fibres become intermingled and separate again only near their destination, when the motor fibres are separated into small branches of the main nerve to supply muscles and the sensory fibres are similarly separated to be distributed as sensory nerves to the skin or mucous membranes.

### Structure of a Nerve Unit.

By a nerve unit is meant the nerve cell and its prolongation forming the nerve fibre.

The nerve cell is angular in shape, and has passing from it a large number of minute processes called *Dendrites*, which ramify in all directions and come in intimate contact with those of

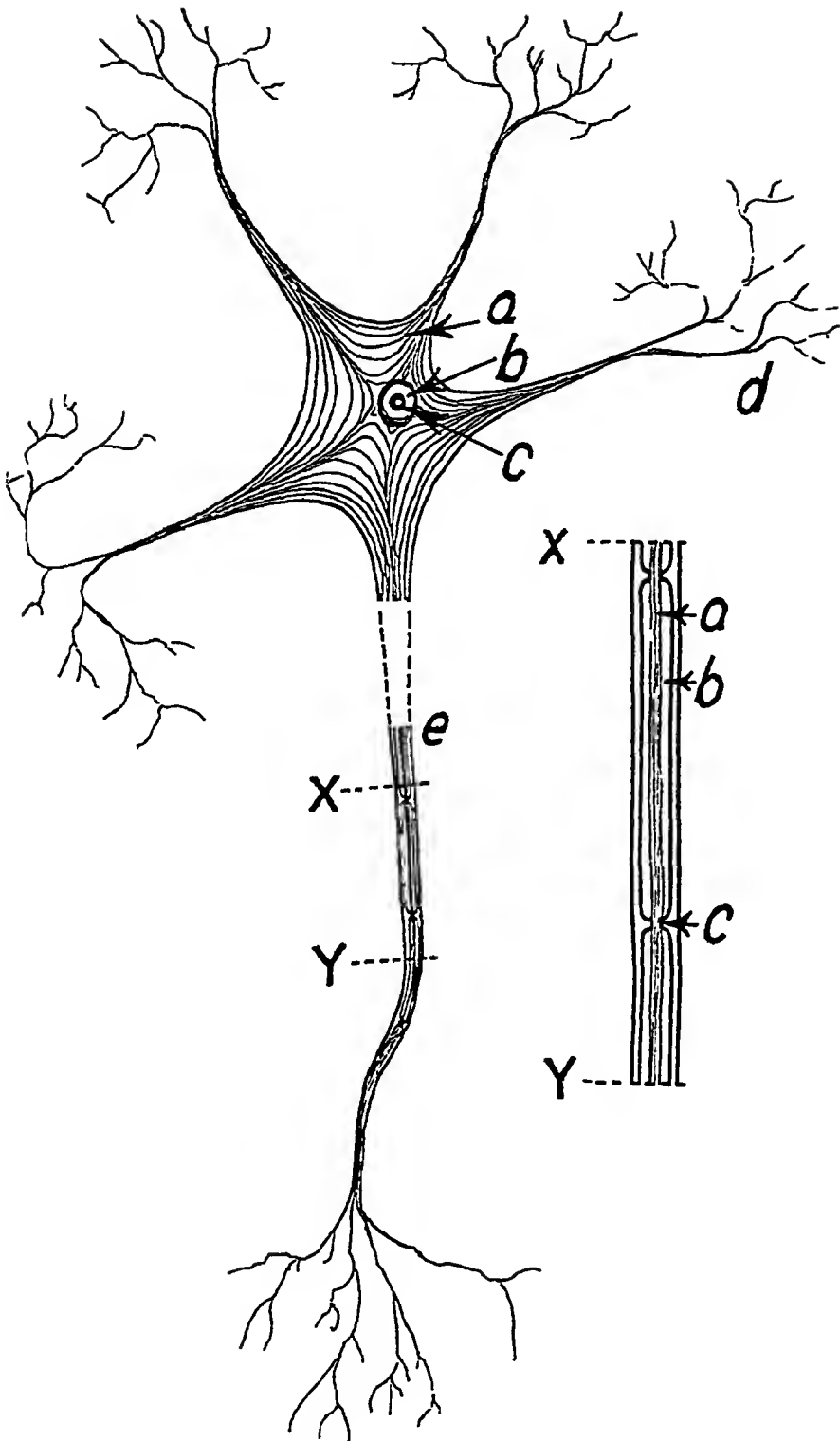


FIG 41 —NERVE CELL AND FIBRE

*a* = Cell body  
*b* = Nucleus  
*c* = Nucleolus  
*d* = Dendrite  
*e* = Main nerve fibre or axon

Inset—  
*a* = Nerve fibrils  
*b* = Medullary sheath  
*c* = Node

neighbouring nerve cells. Some nerve cells found in the brain are of this type, but the majority, in addition to the fine dendrites, send out one long process which may be many inches or even 2 or 3 ft in length, and in which no nucleus is found apart from that in the cell itself. A collection of such fibres forms the ordinary mixed nerve. The single nerve fibre has a peculiar structure, consisting of a central core of fibrillar material, surrounded by a sheath of *Myelin*. This sheath of myelin (or medullary sheath) is constricted at regular intervals along the nerve fibre forming nodes. Outside the medullary sheath is a thin layer of elastic tissue, the *Neurilemma*, in which nuclei are found.

The Sympathetic System fibres have no medullary sheath, but in other respects resemble the fibres of the Central Nervous System.

### Reflex Action.

By a reflex action is meant one which follows immediately upon a sensory stimulus, and is beyond the normal control of the individual, for example, the sudden closing of the eyelids if the eyeball is touched. There are a large number of such reflex actions, which are produced without variation if the same stimulus is employed.

There are an extremely large number of reflex actions taking place in the body, and on these reflex actions depend to a very large extent the functions of the viscera. The proper performance of a reflex act depends on the integrity of the nerve connections between the parts involved and the Central Nervous System (either the brain or the spinal cord).

The simplest form of such connection is composed of an afferent nerve fibre passing from the periphery and carrying a sensory nerve impulse to the spinal cord, where the nerve ending ramifies round a motor nerve cell, whose efferent fibre passes to the muscle activated in the reflex.

Interference in this reflex system at any point will alter or obliterate the nature of the reflex.

This fact is made use of in medicine in order to determine whether there is any gross injury or pathological change in the spinal cord or brain.

A few of the most important of these reflexes may be mentioned

**THE CORNEAL REFLEX** This consists of the sudden involuntary closing of the eye when the *Cornea* (central clear portion of the eye) is touched. The value of this lies in the removal, by this movement, from the cornea, of any foreign body that has entered the eye. It is one made use of very frequently by anaesthetists to test the depth of anaesthesia of the patient.

**LIGHT REFLEX** This is the contraction of the pupil (circular fibres of the iris) when light enters the eye, the afferent path being the optic nerve. This reflex is absent in certain brain diseases, and its absence is characteristic of the disease *Tabes Dorsalis* (Locomotor Ataxy). It is abolished during deep surgical anaesthesia.

**KNEE JERKS** This well-known reflex is elicited by tapping the patellar ligament when this is on the stretch, e.g. when the knee is flexed. This tap causes the quadriceps to contract suddenly and involuntarily, and so gives rise to a sudden extension of the knee. Marked exaggeration or complete absence of this reflex indicates some pathological condition of the central nervous system. The reflex varies greatly in character in normal individuals.

This is one of the easiest of the "tendon reflexes" to elicit, but the muscle activating any tendon will similarly suddenly contract if the tendon can be put a little on the stretch and tapped in this position. Other tendon reflexes are those of the *Tendo Achilles*, *Triceps Tendon*, and *Wrist Tendons*.

**BABINSKI'S SIGN** This reflex is caused by lightly stroking the skin of the sole of the foot immediately beneath the first metatarsal bone. Normally this causes a reflex contraction of the flexor tendon of the toe which is, therefore, flexed. In diseases of the upper part of the spinal cord, or of the brain, this reflex is frequently altered so that the toe is extended instead of being flexed. This abnormal movement is known as Babinski's Sign. The reflex is known as the plantar reflex, and is said to be flexor or extensor, as the case may be.

### Classification of Sensations.

There are a very large number of different sensory impulses which are carried by the afferent nerves. These are the special sensations such as Vision, Hearing, Smell, and Taste, conveyed by



nerves specialized for the purpose, and also the ordinary sensations of Touch, Pain, Heat, and Cold, etc., conveyed by the ordinary cranial and spinal peripheral nerves

With regard to the special sense impulses, these are constant in kind however the special nerve is stimulated, e.g. the optic nerve gives the sensation of light to the brain when it is stimulated by light waves or by pressure or other form of injury, hence the common experience of "seeing stars" if the eyeball is struck, the pressure in this case being transmitted to the optic nerve through the eyeball. A violent blow on the head may give the same effect by causing a "shake up" of the optic nerve in its passage from the brain to the eyeball through the skull

Similarly for the other special sense nerves

With regard to the peripheral nerves, the sensory fibres of these convey all the varieties of sensation of touch, pain, heat, and cold, but it is generally held that the separate fibres of which these nerves are composed convey only one of these sensations, i.e. there are special fibres to convey the sensation of heat, others of cold, others of touch, and others of pain. This view is borne out by the fact that the skin can be shown to contain innumerable "spots" of minute size scattered irregularly all over its surface, which convey only the sensation of heat, and others only the sensation of cold. If the cold spots are stimulated by a warm pencil they will not convey a sensation of heat, but a sensation of pressure will be the only result. Again, in certain diseases some sensations will be affected and not others. These facts all go to support the now generally accepted view that these sensations are each conveyed by separate nerve fibres

Apart from the sensations already mentioned, there are others conveyed by the afferent fibres such as the sensation of pressure, apart from touch or pain, of muscle sense, by which co-ordination of muscular action is maintained, of joint sense, by which the position (flexion, extension, etc.) of the joints is recognized

The main sensory impulses may, therefore, be classified into those of (1) Sight, (2) Smell, (3) Hearing, (4) Taste, (5) Touch, (6) Pain, (7) Heat, (8) Cold, (9) Muscle Sense, (10) Joint Sense

All the sensory nerve fibres become separated from the motor fibres in a mixed nerve at the point of division into the anterior

and posterior roots described in the previous chapter, and the sensory are all collected into the posterior root, while the motor form the anterior root.

In the spinal cord the same relative position is maintained, the sensory tracts of nerve fibres lying behind and the motor in front

## SYMPATHETIC SYSTEM

The sympathetic nerves arise in the ganglia of the system, and communicate with the spinal nerves, so establishing a connection with the central nervous system, the spinal nerves also send branches to join the sympathetic nerves. In this way two branches of communication are established between the two systems.

The branch of communication from the central nervous system comes ultimately from controlling nerve centres in the brain.

The function of the sympathetic nerves is to control the visceral activities of the body. For example, they control the circulation by causing constriction and relaxation of the arteries; they control the secretions of the various glands, e.g. salivary, pancreas, breast, liver, etc. They control the heart's action, and the movements of the intestines, the pupil and the lacrymal gland. They are, in fact, the controlling nerve supply of all the involuntary muscles of the body, and of the glandular and other activities not controlled voluntarily.

### Vasomotor Nerves.

These exercise a powerful control over the circulation by causing constriction of the arteries, and so, by diminishing the calibre of the vessel, raising the blood pressure. These nerves are in tonic action, i.e. are constantly causing a slight tonic contraction of the arterial walls. If this action is interfered with the blood vessels will dilate and cause increased flow through the vessels, giving rise to redness of the parts concerned. On the other hand, if their action is stimulated, contraction of the vessels will cause a certain amount of blanching and an increase in the blood pressure. These effects are produced, normally, by reflex action according to the needs of the body. A typical example of the involuntary inhibition of the tonic action of these nerves is shown in the act of blushing, when the cutaneous blood vessels of the face and neck

are dilated For further details concerning the control of the heart beat by the cardiac nerves, see Chapter X

### Cerebro-spinal Fluid.

The brain and spinal cord lie in a bath of fluid which surrounds them This fluid is also contained in the ventricles of the brain, and is called the Cerebro-spinal fluid

The cerebro-spinal fluid is a clear watery fluid consisting of water with salts in solution derived from the blood plasma

The fluid is probably formed from the lining of the ventricles of the brain, and is derived from the vessels lying in folds of this lining It is probably absorbed along the sheaths of the nerves In cases of inflammation of the lining of the brain (*Menigitis*) the tension of the cerebro-spinal fluid is increased, as is shown by passing a hollow needle into the spinal canal, and in these cases the fluid may also contain pus

## CHAPTER IX

### ANATOMY OF THE CIRCULATORY SYSTEM

THE Circulatory System is the means by which blood is conveyed to all parts of the body, so that each cell comes in contact with it, and from it can obtain the oxygen and other nutritive substances necessary for the building up of its protoplasm and its functional activity, and into it can excrete the waste products of its activity. The system consists of a central pump, the *Heart*, which drives the blood through arterial blood vessels with comparatively thick, elastic, and muscular walls, to the most distant parts of the body.

The arteries are merely the conduit pipes through which the blood is directed, and the nutritive contents of the blood cannot be absorbed from these as the walls are too thick.

As the main arterial vessels pass to their destination, they gradually decrease in size by branching, and the walls become correspondingly thinner until the smallest visible arterial

branches are reached, called *Arterioles*. Each arteriole breaks up into a very large number of extremely thin-walled vessels, called *Capillaries*. These are invisible to the naked eye, and the walls consist of only one layer of cells. It is through these extremely tenuous walls that the interchange of material between the blood and the cells takes place. When the blood has passed through

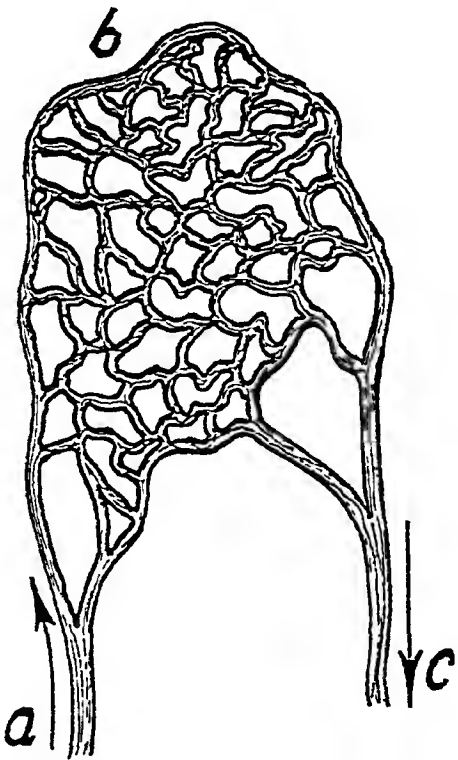


FIG 42—DIAGRAM SHOWING AN ARTERIOLE (a) BREAKING UP INTO A NETWORK OF CAPILLARIES (b) FROM WHICH THE BLOOD IS DRAINED BY THE VENULE (c)

these capillaries, they unite again into larger vessels, called *Venules*, and these again unite with each other to form *Veins*

The veins are generally of larger calibre than the corresponding arteries, but their walls are not so thick. The blood is thus returned to the great venous trunks which convey it to the heart. This is the main general circulation of the blood, but in addition, there is the pulmonary circulation, which is constructed on exactly the same principles and serves the purpose of conveying the deoxygenated blood when it has returned to the heart, to the lungs, where it is oxygenated again, conveyed back to the heart and then into the general circulation once more.

### Portal Circulation.

The veins of the intestinal tract are all collected into one main vein, the *Portal Vein*, which does not return direct to the heart, but enters the liver, and there breaks up again into capillaries. The blood is collected from the liver into the *Hepatic Veins*, which pass into one of the main venous trunks going to the heart. In this way the material absorbed from the intestines is passed in the blood through the liver before reaching the general circulation.

### The Heart.

The heart is a powerful muscular organ situated in the cavity of the thorax, just to the left of the middle line. It is placed rather obliquely and is conical in shape, so that the apex lies forwards and to the left, while the base lies rather more posteriorly and in the middle line. The superficial area of the chest wall, beneath which the heart lies, is bounded by the lower border of the left second costal cartilage, the upper border of the right third costal cartilage, the junction of the seventh right costal cartilage and the sternum, and a point in the fifth left intercostal space, about half an inch inside the nipple line. If these points be joined the area so marked out represents fairly accurately the position of the underlying heart.

The apex of the heart lies just to the inner side of the left nipple line, in the fifth intercostal space, and can usually be felt beating in that position. The rest of the heart cannot be felt beating owing to the inclination of the organ away from the chest wall.

The main structures in close contact with the heart, or in anatomical words, the heart's relations, are—

1 On each side, the lungs

2 In front, the lungs overlap the heart in its upper part, but there is a notch in the margin of the left lung which allows the apex of the heart to come forwards to the front chest wall. This part of the heart, therefore, is in direct relationship to the posterior surface of the front wall of the chest

3 Behind the heart lies the *Oesophagus*

4 Below, the heart rests on the diaphragm, which separates it from the abdominal cavity. Immediately below the part of the diaphragm on which the heart rests, lies the left lobe of the liver and the stomach

**PERICARDIUM** The heart is completely enveloped, except where the great blood vessels enter and emerge, by a fibrous bag, called the pericardium. This is attached below to the diaphragm, and so assists in keeping the heart in its proper position. Lining the fibrous pericardium is a thin layer of serous membrane, called the *Serous Pericardium*. This forms a double layer, one lining the pericardium and the other covering the heart, so that the heart muscle does not come in direct contact with the fibrous pericardium, but is separated from it by the two serous layers, which are covered on their opposing surfaces by a thin film of fluid and so provide smooth lubricated surfaces, avoiding the friction which would otherwise inevitably occur during each heart beat

**STRUCTURE OF THE HEART** The heart is composed almost entirely of muscle fibre, and consists of four cavities or chambers, two *Auricles*, right and left, above, and two *Ventricles*, right and left, below

The right auricle and ventricle communicate with one another, as do the left auricle and ventricle, but there are no communications between the right and left auricles nor between the right and left ventricles

The openings between the auricles and ventricles are valvular, allowing blood to pass in one direction only, i.e. from the auricle to the ventricle. The valves guarding these orifices are composed of extremely thin fibrous layers, attached by their outer border to the circumference of the orifice, and having a free inner border

controlled by thin fibrous cords attached to the walls of each ventricle.

The valve on the right side is called the *Tricuspid Valve*, as it consists of three flaps. When the right ventricle contracts the blood is forced against the under surface of these flaps and pushes them upwards. The free edges of the flaps are thus brought together and completely close the orifice, preventing any blood from passing into the auricle.

The valve on the left side is called the *Mitral Valve*, and consists of only two flaps, which are brought into apposition when the left ventricle contracts.

**CIRCULATION THROUGH THE HEART** The blood enters the heart on the right side, being brought to the right auricle by two very large veins, the *Superior* and *Inferior Vena Cava*. Into these great veins drains all the blood of the body. When the auricle is filled it contracts and forces the blood into the right ventricle, which then contracts in its turn and, owing to the closure of the tricuspid valve, forces the blood into the two great *Pulmonary Arteries*, which arise from the right ventricle and convey the venous blood to the lungs. After passing through the lungs, and there becoming oxygenated, the blood returns to the left auricle, into which it is conveyed by the pulmonary veins. This auricle then contracts and forces the blood into the left ventricle. The contraction of the left ventricle which then follows, closes the mitral valve and so prevents the blood returning to the auricle, and forces it into the great arterial vessel, the *Aorta*, which conveys it by various branches to the head, trunk, and limbs. The blood is then returned by the veins to the right auricle, and so the circulation is completed.

It must be appreciated that although the various phases of circulation have been described consecutively, the action takes place, to a large extent, continuously, i.e. both auricles contract together, and both ventricles contract together immediately afterwards; and there is thus a wave of contraction which passes from the auricles to the ventricles.

**THE AORTA** This is the largest arterial trunk of the body. It arises from the left ventricle and at first passes upwards. It soon bends over, however, to form an arch, and is continued downwards.

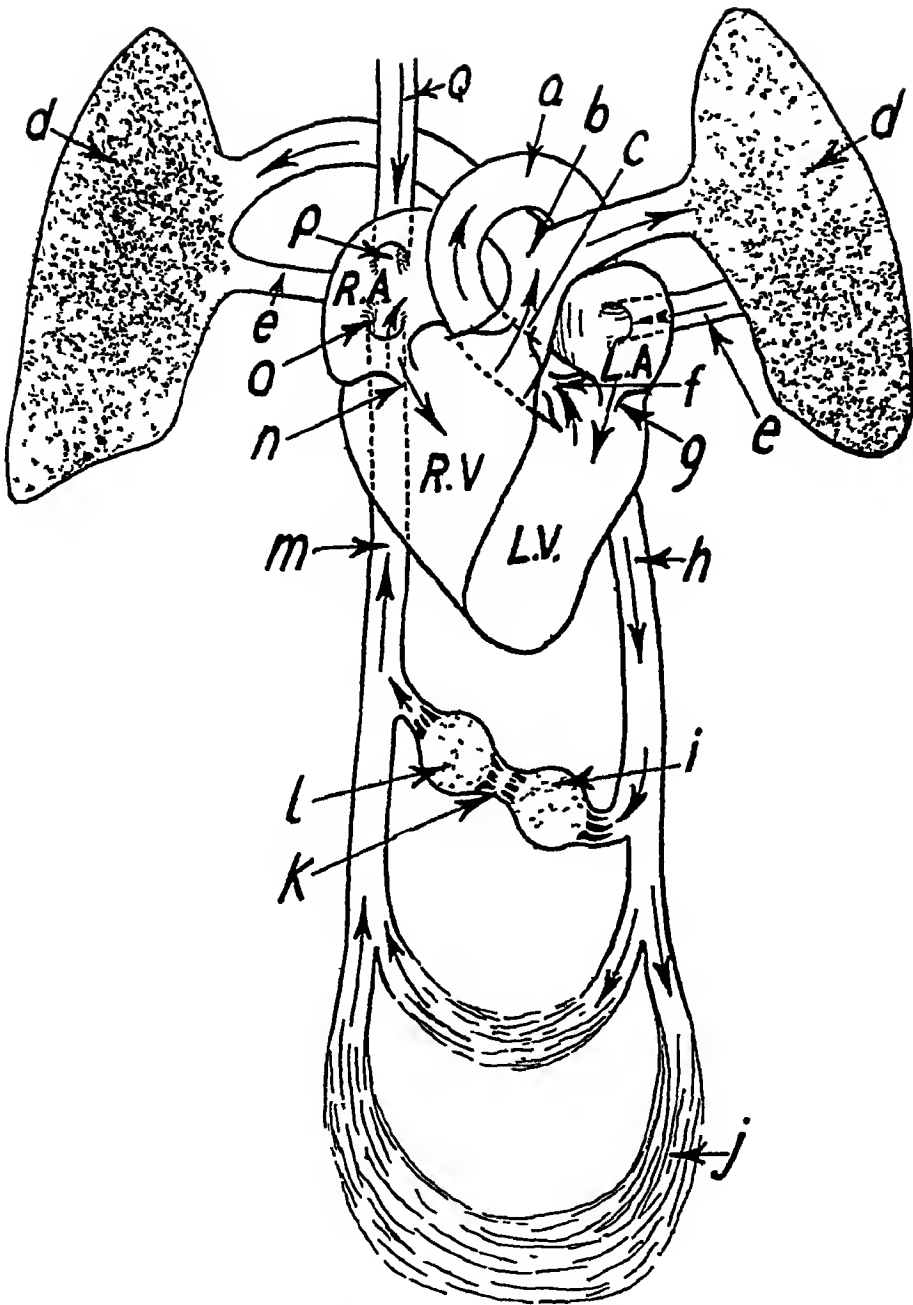


FIG 43 —DIAGRAM OF THE CIRCULATION OF THE BLOOD

The unlettered arrows indicate the direction of the blood flow

- |                             |   |
|-----------------------------|---|
| <i>R A</i> = Right auricle  | <i>R V</i> = Right ventricle                  |
| <i>L A</i> = Left auricle   | <i>L V</i> = Left ventricle                   |
| <i>a</i> = Aorta            | <i>j</i> = Peripheral capillaries             |
| <i>b</i> = Pulmonary artery | <i>k</i> = Portal vein                        |
| <i>c</i> = Pulmonary valves | <i>l</i> = Liver                              |
| <i>d</i> = Lungs            | <i>m</i> = Inferior vena cava                 |
| <i>e</i> = Pulmonary veins  | <i>n</i> = Tricuspid valve                    |
| <i>f</i> = Aortic valves    | <i>o</i> = Opening of the inferior vena cava  |
| <i>g</i> = Mitral valve     | <i>p</i> = Opening of the superior vena cava. |
| <i>h</i> = Descending aorta | <i>q</i> = Superior vena cava.                |
| <i>i</i> = Intestinal tract |   |



behind the heart through the thorax into the abdomen, passing through the diaphragm on its way

The first curved portion of the aorta is called the *Arch of the Aorta*, and from it arise the great vessels supplying the head, neck, and upper limbs. These are named, the *Innominate Artery*, on the right side, which divides into the *Common Carotid* and *Subclavian Artery* supplying the head and neck on the right side and the right arm respectively, and on the left side the aorta gives off the left *Common Carotid* and the left *Subclavian Arteries*, which arise independently from the aortic arch. There is no left innominate artery.

As the aorta passes down through the thorax, it gives off the *Intercostal Vessels*, one to each intercostal space.

In the thorax the aorta lies close to the *Oesophagus*, between the right and left lungs. It lies close to the spinal column, and it maintains this position in the abdomen, where it ends at about the level of the fourth lumbar vertebra by dividing into two common iliac arteries (Right and Left). In the *Abdomen* it gives off several important branches to supply the viscera. The first important one is the *Coeliac Axis*, which divides into branches supplying the stomach, liver, spleen, and pancreas.

In addition to this two other branches, the *Superior* and *Inferior Mesenteric* are given off lower down to supply the small and large intestines.

### Arteries of the Head, Neck, and Upper Limb.

1 HEAD AND NECK. The main vessels are the common carotids, right and left, whose origin has been described above. The right common carotid arises from the innominate, at the level of the sterno-clavicular joint. From this point onwards the arteries have the same course and distribution on each side.

The common carotid runs upwards beneath the anterior border of the sterno-mastoid muscle until it reaches the level of the cricoid cartilage of the larynx, where it divides into its two main branches, the *Internal* and *External Carotids*.

The *Internal Carotid* is continued upwards, very deep in the neck, to the base of the skull through which it passes, and is distributed to the brain.

The *External Carotid* is distributed to the soft parts of the head and neck by a large number of branches, of which the most important are—

- (1) *Lingual*, supplying the tongue
- (2) *Facial*, „ „ face
- (3) *Maxillary*, „ „ jaws
- (4) *Temporal*, „ „ side of the head

This latter is the vessel that can be felt and often seen beating as it runs up over the temple, immediately above and in front of the ear.

## 2 THE UPPER LIMB—

(1) *Subclavian* This vessel arises with the common carotid, on the right side from the innominate artery. On the left it arises independently from the arch of the aorta, in either case it arches over the first rib, at the base of the neck, lying immediately behind the collar bone, and then passes downwards and outwards to the axilla, where it is continued as the axillary artery.

The subclavian gives off several large branches in the neck, but these need not be named individually.

(2) *Axillary Artery* This is a continuation of the subclavian, and ends below at the level of the lower border of the fold of the armpit, being then continued down the arm as the *Brachial Artery*.

The axillary artery is very closely related in the axilla to the cords of the brachial plexus, which lie at first above and behind and then practically envelope the vessel. The main branches of the axillary artery are the *subscapular* to the scapular muscles, *thoracic* to the chest wall, and the *circumflex* artery which winds round the neck of the humerus.

(3) *Brachial Artery* This is the main artery of the upper limb, and runs down the inner side of the arm and rather towards the front, immediately beneath the inner border of the biceps muscle. It ends in front of the elbow by dividing into two main branches which supply the forearm, namely, the *Radial* and the *Ulna Arteries*.

In its course down the arm the brachial artery lies close to the median nerve, and gives muscular branches to the muscles of the upper arm and the nutrient vessel to the humerus.

(4) *Radial Artery* This branch passes down the forearm among the muscles on the radial side, passes over the lower end of the

radius to end in the palm of the hand, where it crosses over to join the ulnar artery and so forms an arterial arch, called the *Palmar Arch*. This is a double arch as the radial and ulnar arteries both divide into two branches, one of which runs deeply and the other superficially, each joining with the corresponding branch from the other artery. In wounds of the palm, the superficial palmar arch is often injured and may bleed profusely. As the radial artery passes over the lower end of the radius, it lies immediately beneath the skin, and it is in this position that the pulse of a patient can best be felt.

The branches of the radial are mainly muscular in the forearm, and in the hand this artery is distributed with the ulnar through the palmar arches, by branches arising from these, to the fingers.

(5) *Ulnar Artery* This passes downwards on the inner side of the forearm in front of the ulna, and below the wrist joins with the radial to form the superficial and deep palmar arches.

### Arteries of the Trunk and Lower Limb.

The aorta is continued downwards through the thorax, diaphragm, and abdomen until it reaches the lower border of the fourth lumbar vertebra, where it divides into the right and left common iliac arteries.

On its passage through the thorax, the chief branches are the intercostals, which pass outwards round the chest wall, between each pair of ribs.

In the abdomen several large branches are given off to supply the various viscera, e.g. *Renal Arteries* to the kidneys, *Hepatic Artery* to the liver, *Splenic* to the spleen, and other branches mentioned above to the stomach, intestines, and other viscera, i.e. *Coeliac Axis*, *Superior* and *Inferior Mesenteric Arteries*.

**ILIAC ARTERIES** The common iliac arteries pass outwards for a short distance and then divide into two main branches, the *Internal* and *External Iliac Arteries*. The internal branch is distributed to the pelvic viscera, and the external is continued down to the thigh, passing under Poupart's Ligament. It gives off no branches of importance.

**FEMORAL ARTERY** This is the continuation in the thigh of the external iliac, and passes downwards, inwards, and backwards,

until it reaches the upper part of the space between the hamstring muscles behind the knee (*Popliteal Space*) It gives off many muscular branches in the thigh, the chief of which is called the *Profunda Femoris*

#### POPLITEAL ARTERY

This is the continuation of the femoral artery as it passes behind the knee, in the popliteal space It gives off branches to the knee joint and divides just below the head of the tibia into two main branches, the *Anterior* and *Posterior Tibials*

- a* = Internal carotid
- b* = External carotid
- c* = Left common carotid
- d* = Subclavian (left)
- e* = Axillary
- f* = Brachial
- g* = Radial
- h* = Ulnar
- i* = Palmar arches
- j* = Superior mesenteric
- k* = Renal
- l* = Inferior mesenteric
- m* = Common iliae
- n* = Internal iliae
- o* = Femoral
- p* = Popliteal
- q* = Anterior tibial
- r* = Posterior tibial
- s* = Plantar arches
- t* = Abdominal aorta
- u* = Coeliac axis
- v* = Thoracic aorta with intercostal branches
- w* = Aorta
- x* = Innominate artery
- y* = Right subclavian
- z* = Right common carotid

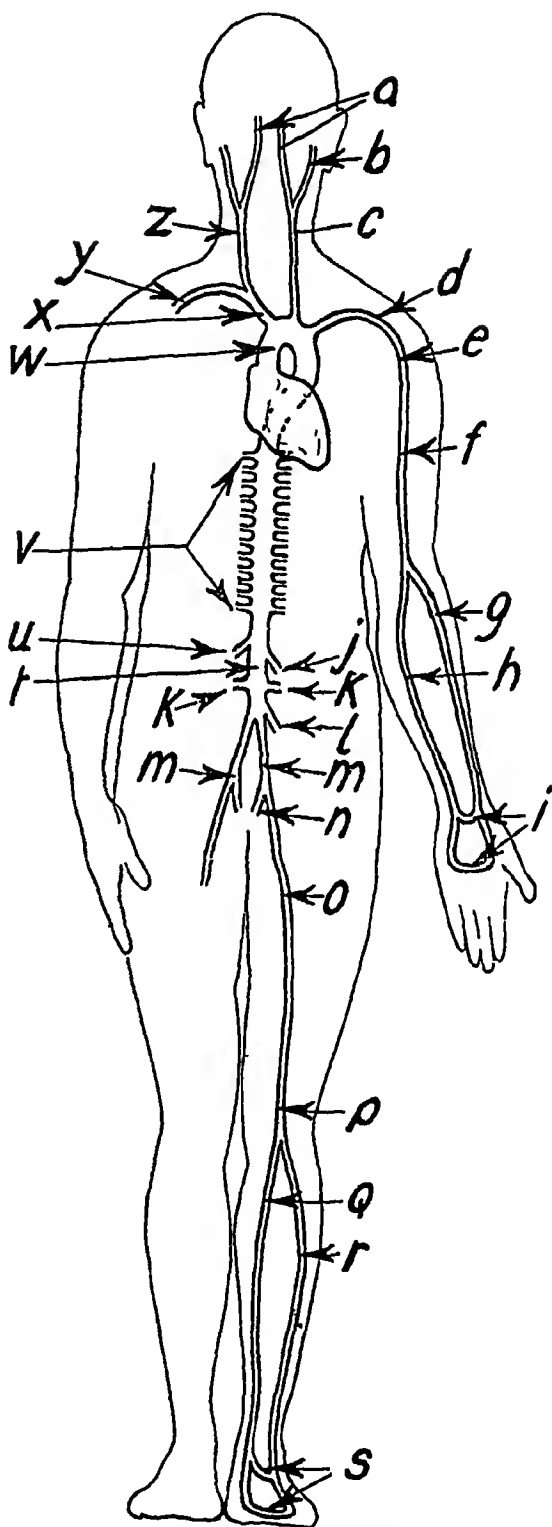


FIG 44—DIAGRAM OF MAIN ARTERIES OF THE BODY

**ANTERIOR TIBIAL ARTERY** This is the main arterial supply to the muscles of the front of the leg, and passes forward between the tibia and fibula to reach these muscles. It is continued down among these until they become tendinous immediately above the ankle joint. The artery here lies between the internal and external malleoli (nearer the former) and is continued into the foot, where it supplies the dorsum or upper part of the foot, and is called the *Dorsalis Pedis*.

**POSTERIOR TIBIAL ARTERY** This artery is the direct continuation down the back of the leg, among the calf muscles, where it lies deeply, of the popliteal artery. It passes across the ankle joint on its inner side, immediately behind the internal malleolus, and is continued in the foot as the plantar artery, which is the chief supply of the sole of the foot.

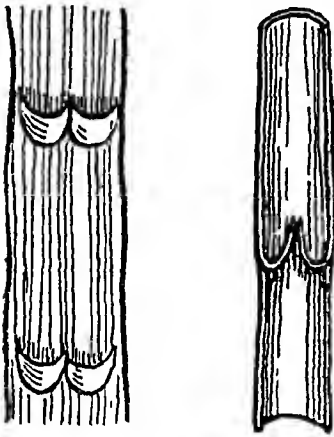


FIG 45—INTERIOR OF VEINS  
SHOWING THE VALVES

The direction of the blood flow is upwards  
in the diagram

### Veins.

The veins of the body travel generally with the corresponding arteries. They are fed by tributaries from the network of capillaries to which the arteries distribute the blood, and are named after the arteries by the side of which they lie. It is unnecessary to recapitulate the names of all these arteries, but there are one or two special veins which should be mentioned.

1 **JUGULAR VEINS** There are two of these, an *Internal* and an *External*. The internal jugular corresponds to the internal carotid and common carotid arteries, and conveys blood from within the skull and the deeper parts of the neck to the heart. It joins below with the subclavian vein to form the right or left innominate veins.

The external jugular conveys blood from the superficial parts of the neck and scalp, and passes downwards between the skin and muscles of the neck, emptying its contents into the internal jugular at the base of the neck.

2 SUPERIOR VENA CAVA This is the large vein formed by the union of the right and left innominate veins, drawing the blood from the upper limbs, neck, and head. It is formed in the upper part of the thorax and passes downwards, to enter the right auricle of the heart.

3 INFERIOR VENA CAVA This is the corresponding main vein drawing blood from below (the trunk and lower limbs). It enters the right auricle immediately below the entrance of the *Superior Vena Cava*.

4 PORTAL VEIN This has already been described under the heading "Portal Circulation."

DIFFERENCES BETWEEN ARTERIES AND VEINS Apart from the fact that arteries convey blood away from the heart and veins towards the heart, there are several anatomical points of difference.

1 The walls of the arteries consist of a mixture of fibrous tissue, elastic tissue, and muscular tissue. The walls of the veins contain much weaker muscular tissue, and their walls are thinner.

2 The diameter of an artery is less than that of the corresponding vein.

3 Veins are provided with reduplicated folds of their innermost coat which stretch across the lumen of the vein and allow blood to pass in one direction only. These folds are called "valves."

## CHAPTER X

### PHYSIOLOGY OF THE CIRCULATORY SYSTEM

THE function of the Circulatory System is to provide means whereby the body cells can obtain oxygen and nutritive material for their growth and activity, and waste products may be removed

In order that this may be carried out effectively, the tissues of the body must be brought into intimate contact with the blood. This is effected by the cells being immersed, as it were, in a sponge-like network of minute capillary vessels into which blood is poured from the arteries and from which it is drained by the veins. These capillaries consist of a single cellular layer, and it is through this layer that the interchange of oxygen, etc., takes place with the cells.

The heart acts as the pump whereby the circulation is maintained in a continuous stream. The heart beats regularly and automatically (i.e. out of control of the will), in man at a normal rate, between 70 and 80 to the minute. The rate is higher than this in children and reaches this figure at adult age, when growth has stopped. In the adult, however, a rate somewhat above 80 or below 60 is not uncommon in a perfectly healthy individual.

The course of the circulation of the blood has been described at the beginning of the preceding chapter.

#### Control of the Circulation.

The heart-beat is controlled by involuntary nerves which originate in the medulla of the brain, and which are stimulated by alterations in the composition of the blood. Thus, if the blood is not being oxygenated sufficiently quickly, the heart will beat more rapidly owing to stimulation of this centre in the brain, and so drive the blood more rapidly through the lungs and through the tissues. Such an effect is produced by muscular exercise when the muscles need more oxygen, and also in the case of lung disease, where the area of lung tissue, and so its oxygenating power, is reduced. On the other hand, the controlling centre in the medulla may be

affected by emotional disturbance in the brain, and in this way the heart may beat more rapidly during conditions of excitement, and may be momentarily slowed in states of mental terror

**EFFECTS OF RESPIRATION ON THE CIRCULATION** The expansion and contraction of the chest wall during respiration has a profound effect on the circulation. Every time the chest is expanded, blood is "sucked" into the great veins near the heart, and so the circulation is aided. In cases of heart disease, where the action of the heart is enfeebled, this pumping action of the lungs is brought more markedly into play and accounts for the breathlessness so commonly associated with heart disease. This breathlessness is an effort on the part of the patient to improve the circulation of the blood, which is becoming ineffective owing to the weakened action of the heart.

**LOCAL CONTROL OF THE CIRCULATION** The arteries and capillaries are supplied with special nerves by whose action the diameter of the vessels can be contracted or expanded. This is effected by the contraction of the muscular tissue in the arterial walls. The nerves are called *Vaso-motor Nerves*, and by their action the local blood supply to any part can be increased or diminished. To take two ordinary examples—

(a) After a meal it is desirable to have a very full blood supply to the stomach and intestines, in order to absorb the material digested with the meal. Vaso dilatation of the visceral vessels therefore takes place, and the blood is in this way much increased in amount in the intestines. As, however, there is only a fixed amount of blood in the body, the rest of the body for a time has a relatively smaller quantity of blood sent to it. The result of this is shown in the case of the brain by the sleepiness, due to cerebral anaemia, following a large meal.

(b) If any part of the body is damaged and repair is necessary, the part needs more blood for this purpose, and a local flushing takes place. This is most marked in cases where some poisonous organism or bacterium has gained entrance through a wound, and the resulting redness is spoken of as "Inflammation."

**BLOOD PRESSURE** In order that the interchange between cells and blood can take place freely, and in order to maintain a rapid and continuous flow of blood through the body, the blood must



exert a definite pressure on the arterial and capillary walls. This pressure is known as the blood pressure, and is measured by the amount of external force (estimated by the pressure exerted by a column of mercury) necessary to overcome the pressure of the blood by obliteration of the lumen of the artery and so stopping the pulse. Normally the pressure necessary to effect this is from 120–130 millimetres of mercury. The passage of oxygen from the blood to the tissues is dependent on this pressure being maintained, and after muscular action the blood pressure is normally raised.

In old age, owing to the loss of elasticity in the arteries, the blood pressure increases, and a continuous pressure of 200 mm. of mercury is not uncommon. The walls of the arteries, however, cannot stand a pressure much above this, and the giving way of a degenerate vessel under these conditions is a common catastrophe, causing haemorrhage. Occurring in the brain, as it frequently does owing to the lack of any firm muscular support for the vessels, such a haemorrhage causes paralysis, and is known as "Apoplexy."

The blood pressure is measured clinically by an instrument known as a Sphygmomanometer, consisting of a pneumatic band (connected with a column of mercury), which is bound round the upper arm and then inflated. As soon as the pressure is sufficient to obliterate the pulse at the wrist, the reading of the mercury is taken, and the air is then gradually let out and a lower reading is found when the pulse returns. The higher of the two readings gives the most accurate measure of the arterial blood pressure.

The normal pressure of the blood is maintained by the tone of the blood vessels, which can be increased or relaxed, generally or locally, by means of the vasomotor nerves (*q v*).

### Physiology of the Heart Beat.

**STRUCTURE OF THE HEART.** The heart is entirely composed of muscle and fibrous tissue. The thickness of the muscle wall varies in different parts of the heart, being thinnest in the auricles and thickest in the left ventricle. The thickness of the muscle is, of course, dependent upon the amount of work that it has to do; thus the left ventricle has to drive the blood round the entire body, the right ventricle drives the blood through the lungs only, and the

auricles merely squeeze the blood from themselves into the ventricles

Within the heart, as has been mentioned in the previous chapter, valves separate each auricle from its corresponding ventricle, and these valves consist of extremely thin fibrous "Flaps," to the free edge of which are attached tendinous fibres arising from small nipple-like muscles projecting from the inner side of the wall of the ventricle. These fibres, or *Chordae Tendineae*, prevent the valves from being pushed backwards, or inverted, after they are closed, and so aid in preventing regurgitation of blood from the ventricle to the auricle.

The openings of the pulmonary artery and aorta are also guarded by valves, which prevent the blood from flowing back into the heart after it has once been expelled. These valves are not provided with chordae tendineae. The general manner in which the heart beats, and in which the blood flows through the heart, has already been described (Chapter IX.)

**HEART RHYTHM** The regular beat of the heart, contraction of auricles followed by contraction of ventricles, is the most striking feature of the heart as a muscular organ. On this regular beat depends the regular and efficient circulation of the blood and the regularity is dependent on the integrity of a small bundle of modified muscle fibres, which pass from the auricles to the ventricles, and so establish a connecting link between these cavities which otherwise have no direct muscular continuity.

The wave of contraction passes down this bundle, from auricle to ventricle, and so the continuity and regularity of the beat is maintained.

**HEART MUSCLE** This differs from ordinary muscle in its inherent power of rhythmic contraction. This "automatic contractility" has not yet been explained, but it is known that the salts of calcium, potassium, and sodium have a marked effect in slowing or increasing the rate of rhythm.

**HEART NERVES** There are two sets of nerves controlling the heart beat, namely the *Inhibitory* and the *Accelerator Nerves*. Both these are derived from the central nervous system, the former directly from the brain (floor of the fourth ventricle in the medulla), and the latter indirectly through the sympathetic nerve system.

The main nerve inhibiting (i.e. slowing the action of the heart) is the *Vagus* (tenth cranial nerve). The accelerator fibres pass outwards, incorporated with two or three of the spinal nerves in the upper thoracic region, and pass by way of the sympathetic ganglia to the heart.

**RATE OF HEART BEAT** By a normal pulse rate is meant a pulse rate which is found in a normally healthy adult when at rest. Great variability is found in this rate, and one individual may have a perfectly normal pulse rate of 90 and another individual equally healthy may have a rate of 50. The majority have a pulse rate of between 70 and 80. Normal variations are according to sex, size, and age.

Normally a woman has a higher pulse rate (70–80) than a man (70). The taller the individual the slower the pulse.

Variation with age—

At birth the rate is about 130–140

In childhood the rate is 90–100

In youth           ,,       ,, 80–90

In adult           ,,       ,, 70–80

#### PHYSIOLOGICAL CAUSES OF ALTERATION IN PULSE RATE—

**Muscular Action** The increased rate caused by muscular action has already been mentioned. It is largely due to the stimulation of the cardiac nerve centres in the medulla of the brain by the products of oxidation which are formed when muscular tissue contracts, and which circulate in the blood.

**Temperature** The pulse rate increases with the temperature of the blood. Thus, if accompanied by dilatation of the skin vessels, encourages loss of heat by radiation from the skin, and so the temperature is automatically lowered.

**Increase of Blood Pressure** With increase of blood pressure the pulse rate is lowered and with diminished blood pressure the pulse rate is increased.

#### Venous Circulation.

The return of the blood from the periphery to the heart is effected through the veins. These show no pulsation as this effect of the heart's action has been obliterated by the passage of the blood.

through the vast network of capillaries. The blood, therefore, travels in a steady stream back to the heart through the veins.

The majority of veins have, at irregular intervals, valves, caused by a reduplication or folding of the innermost lining of the vessel. These allow the blood to pass in one direction only, i.e. towards the heart. If the valves become inefficient, the blood flow is impeded and the veins may become distended (varicose veins). This action of the veins is of greatest importance in the limbs (particularly the lower limbs) where there is a long column of blood to be supported when the individual is standing upright.

The return of blood to the heart is also aided by muscular action, for the contraction of the muscles squeezes the blood vessels, and so aids in the passage of the blood along the veins. It is for this reason that very rapidly it becomes extremely uncomfortable to stand perfectly immobile.

### Portal Circulation.

The portal system has been described in the preceding chapter. Its function is to convey the blood filled with absorbed food material from the intestines to the liver, where the food material is converted and stored and made available for the needs of the body. (See "Physiology of Digestion," Chapter XIV.) The portal system of veins has no valves.

### Physiology of the Blood.

The blood is the means whereby the living tissues of the body are provided with oxygen and food material, including fluid, and whereby also the waste products of the activity of the cells are conveyed either to the lungs or kidneys, by which they are excreted.

Apart from this general function, the blood has many others, among the most important of which are those dealing with the repair of tissue damage and the protection of the body from the invasion of bacteria.

**STRUCTURE OF BLOOD** The blood is a red, rather sticky fluid, and consists of water, inorganic salts in solution, albuminous material also in solution, and blood corpuscles in suspension. The fluid part of the blood is called *Plasma*. The salts are those of

sodium, potassium, magnesium, iron, and calcium (principally) These form about 1 per cent of the blood Water forms about 80 per cent *Protein* in solution amounts to about 4 per cent, and the remainder is made up of the blood cells and variable quantities of fats and sugar

*The percentage of salts* is very constant, and if it is increased or diminished to any great extent the percentage is rectified by the absorption of water from the tissues into the blood, or vice versa

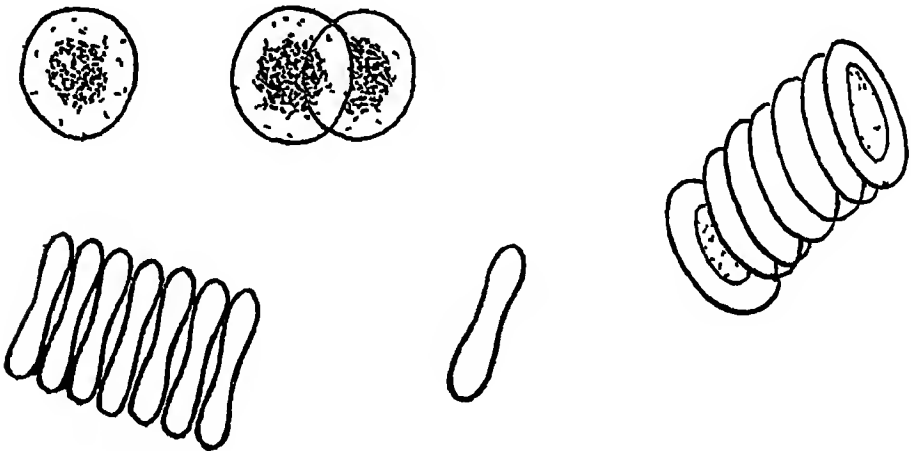


FIG 46 —RED BLOOD CORPUSCLES

*Albumen* These are of several kinds, but their chief characteristic is that they coagulate, or are converted into a jelly-like substance on being heated They consist, chemically, of very complicated molecules containing carbon, hydrogen, oxygen, nitrogen, sulphur, and phosphorus

**BLOOD CELLS** There are two varieties of blood cells, *White* and *Red* The red largely outnumber the white, the normal number per cubic millimeter being respectively 5,000,000 and 8,000–10,000

These two types of cell have very different functions *The Red Blood Cell* is a circular disc, rather thicker at its circumference than at its centre, and contains no nucleus Its characteristic constituent is *Haemoglobin*, which is an albuminous substance containing iron, and which is of a red colour The haemoglobin has the property of absorbing oxygen from the air in the lungs (forming a bright red compound, called *Oxy-haemoglobin*), and of acting as a carrier of this oxygen to the tissues which absorb it and convert

the oxy-haemoglobin into *Reduced Haemoglobin*. This change causes the blood to lose its bright red colour and to this cause is attributable the difference in colour between arterial and venous blood.

*The White Blood Corpuscles (Leucocytes)* These are colourless, irregular-shaped cells, consisting of a clear protoplasmic body within which is a specialized spot of protoplasm, called the nucleus. There are several forms of these, the chief of which are *Lymphocytes* (small and large), characterized by a simple rounded nucleus.

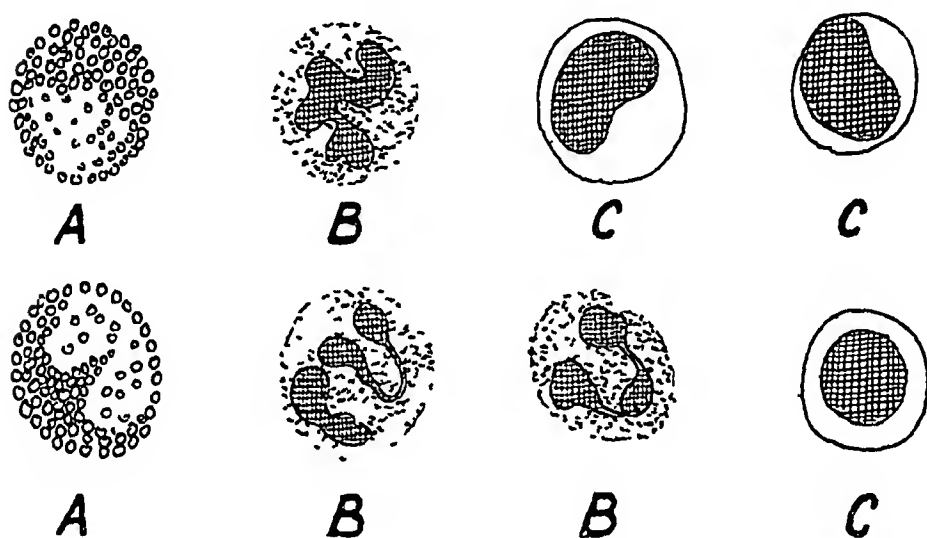


FIG 47—WHITE BLOOD CORPUSCLES (LEUCOCYTES)

a = Eosinophil corpuscles with large granules  
 b = Polymorpho nuclear leucocytes, i.e. leucocytes with lobulated nuclei  
 c = Large mono nuclear leucocytes (lymphocytes)

*Small Lymphocytes* amount to 25 per cent of all white corpuscles and *Large Lymphocytes* to 1 per cent.

*Polymorphonuclear Leucocytes*, characterized by a lobulated nucleus, sometimes consisting of several lobes connected by slender protoplasmic strands. These form 60–75 per cent of all white cells.

The total number of leucocytes may vary considerably in health, but in cases of septic infection and in certain diseases they are greatly increased in number, and this increase is known as a condition of *Leucocytosis*. A diminution in their number is known as *Leucopenia*.

*Function of the White Blood Corpuscles* The chief characteristic

of the white corpuscles is their power of independent movement. These movements are carried out by a "crawling" motion of the protoplasm, and in this way certain of the leucocytes are enabled to migrate through minute spaces in the walls of the capillary vessels into the neighbouring tissues. This power is of great importance in enabling the leucocytes to carry out their function of absorbing cells killed by injury or poison in the tissues, and in destroying bacteria. This latter is their chief function. The white blood corpuscles are the fighters of the body, and it is on them that the resisting power of the body to invading organisms chiefly rests. Normally there are not sufficient white cells to meet a strong bacterial invasion, but if such an invasion occurs, large numbers of white cells are produced in the blood, and the number per cubic millimeter may increase up to 20,000 or 30,000.

**ANTITOXINS** These are chemical substances formed in the blood to counteract poisons or toxins produced by bacteria. The reaction of the blood is extraordinarily sensitive, and to almost every form of toxin an antitoxin can be formed by the blood. If the power of the blood in antitoxin production is diminished, or if the production of toxin by invading bacteria is excessive, the poison will circulate in the blood, and the condition known as *Toxaemia* or blood-poisoning, is produced.

It is an interesting fact that the blood normally produces much more antitoxin than is necessary to deal with the amount of toxin present in the blood, and this is made use of in the preparation of antitoxic serums. If a horse, or other large animal, is inoculated with any specified bacteria, he will produce large quantities of antitoxin which can then be extracted from the blood, and used as an injection to counteract the poison from a similar organism in a patient whose resisting power is low.

**COAGULATION OF BLOOD** It is common knowledge that blood clots when it is shed. This process is known as coagulation, and is caused by the development in the blood of an insoluble albuminous compound, called *Fibrin*. Fibrin is not normally present in the blood, but there is a substance known as *Fibrinogen* constantly present which, under suitable conditions, becomes converted into fibrin. Such conditions are, broadly speaking, contact with any foreign body, e.g. a hair or dead tissue cell, the sides of a containing

vessel, or almost any other substance not normally found in the blood will lead to coagulation

The clot thus formed consists of fibrin and entangled blood cells, and the remaining clear fluid is known as the blood serum. It is by virtue of the clotting power of the blood that bleeding ceases in a small cut, the ends of the severed blood vessels being plugged with small clots which prevent further haemorrhage.



## CHAPTER XI

### ANATOMY OF THE RESPIRATORY SYSTEM

THE Respiratory System consists of the nose, naso-pharynx, larynx, trachea, and lungs

The anatomy of the nose is described elsewhere (See Chapter XX)

#### Naso-Pharynx.

This is the space lying behind the nose and continuous below with the posterior part of the cavity of the mouth, from which it is partially separated by the soft palate

The septum of the nose ends behind in a free border and the two nasal cavities open, therefore, into a common space at the back. These openings are called the *Posterior Nares*, and the space at the back is the *Naso-pharynx*. This is bounded above by the base of the skull (body of the *Sphenoid*) and behind by the muscles covering the front of the cervical spine. Below is the soft palate, which stretches backwards but does not in its normal position touch the posterior wall. It does so, however, during the act of swallowing, and so prevents food passing up into the naso-pharynx.

The naso-pharynx is lined by mucous membrane and, besides the openings of the posterior nares, there are two other passages which open into it, namely the Eustachian Tubes.

**EUSTACHIAN TUBES** These are two in number, one on each side. They pass from the middle ear forwards through the petrous portion of the temporal bone, and open into the lower part of the Naso-pharynx on each side. They are lined with mucous membrane, and after they leave the temporal bone they are formed of cartilage. As long as they are unobstructed they maintain the normal atmospheric pressure in the middle ear.

They are, however, a source of danger as it is easy to see how infection may spread from the naso-pharynx along these tubes and so infect the middle ear.

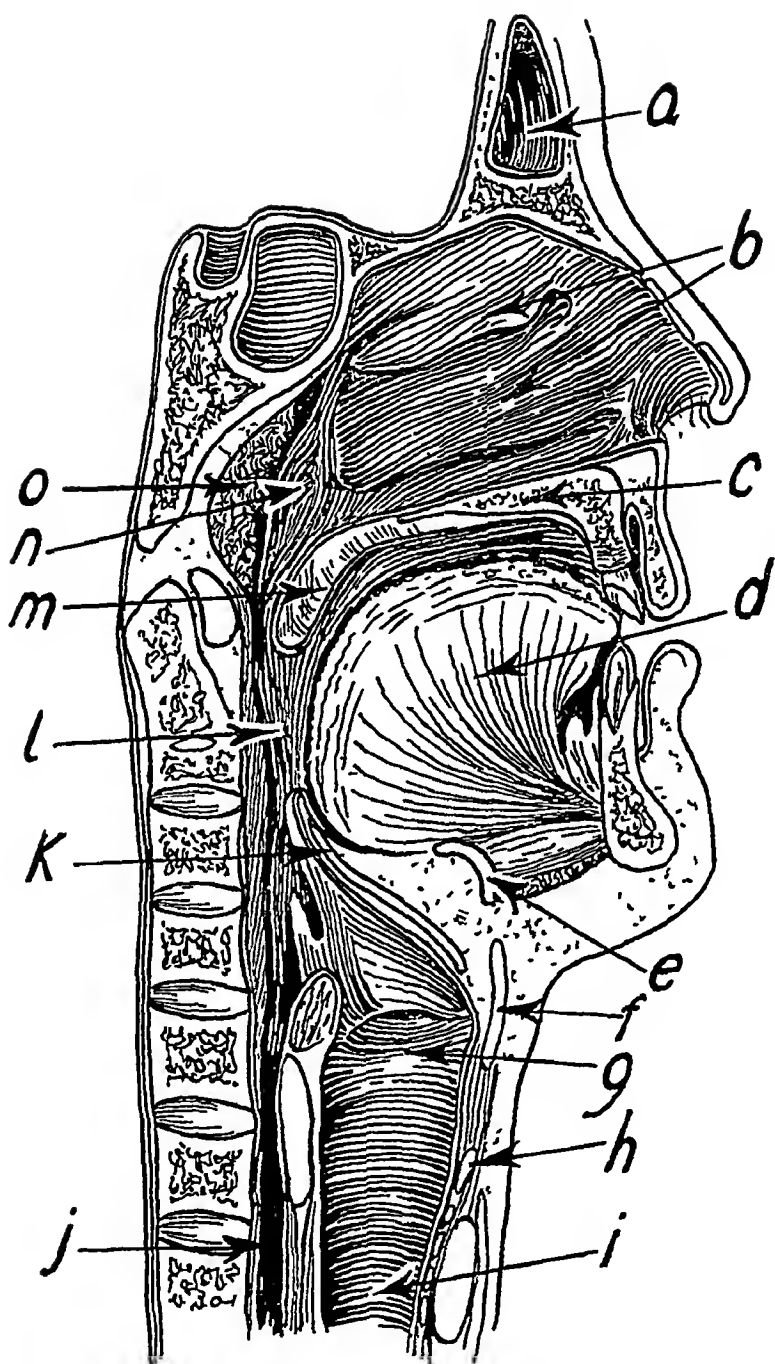


FIG 48—SECTION THROUGH THE HEAD AND NECK SHOWING THE NASO-PHARYNX, ETC

- |                       |  |
|-----------------------|--|
| a = Frontal sinus     | j = Oesophagus   |
| b = Turbinal bones    | k = Epiglottis   |
| c = Hard palate       | l = Pharynx  |
| d = Tongue            | m = Soft palate  |
| e = Hyoid bone        | n = Opening of Eustachian tube into the naso-pharynx                                 |
| f = Thyroid cartilage | o = Lymphoid tissue (excess of which forms adenoids) at the back of the naso-pharynx |
| g = Vocal cords       |  |
| h = Cricoid cartilage |  |
| i = Trachea           |  |

## Larynx.

This is the upper part of the respiratory passage in the neck, and contains the vocal cords. It is lined by mucous membrane.

It is formed of a series of cartilages, the *Thyroid*, *Cricoid*, and *Arytenoid Cartilages*, which have been described in Chapter I.

The upper end of the larynx opens immediately behind the tongue. Immediately behind it lies the *Oesophagus*, and in front, and at the sides, it is covered by the deep muscles of the neck and the thyroid gland, except in the middle line in front, where the cartilages can be clearly felt immediately beneath the skin.

The Adam's Apple is formed by the front of the Thyroid Cartilage.

The *Epiglottis* lies immediately above and in front of it.

**VOCAL CORDS** These lie within the larynx, and are formed by a folding of the mucous membrane lining the larynx, over two fibrous cords which stretch from the *Arytenoid Cartilages* behind to the middle point of the thyroid cartilage in front. (See Fig 48)

## Trachea or Windpipe.

The larynx is continued below into the trachea, which is a tubular structure passing down the neck into the thorax. It is formed of a series of rings of cartilage which prevent it from collapsing, and is lined, like the rest of the respiratory tract, by mucous membrane.

It ends below in the thorax, at the level of the upper border of the fifth dorsal vertebra, by dividing into two main branches, the *Right* and *Left Bronchi*. These then break up into smaller branches, which are distributed to the lungs.

**RELATIONS OF THE TRACHEA** In the neck the most important relation of the trachea is the thyroid gland (*qv*), the isthmus of which comes in front of it. In cases of enlargement of this gland, therefore, the trachea is liable to become obstructed.

Behind the trachea lies the oesophagus. It also comes into close relations with the common carotid arteries, the innominate artery and the arch of the aorta.

## Lungs.

These are the essential organs of respiration, and are situated within the thorax, and are therefore surrounded on all sides by the

ribs, except below where the diaphragm separates them from the abdomen, and above, where the apex of each lung rises just above the level of the clavicle in the neck

**GENERAL STRUCTURE OF THE LUNGS** Lung tissue has a sponge-like consistency and is composed of vast numbers of minute air spaces called *Alveoli*. These are attached like buds on a stem to minute tubes called *Bronchioles*, which are the terminal branches of the bronchi. The bronchioles are provided with circular muscle fibres which, by their contraction, diminish the size of the bronchioles. A form of asthma is said to be due to nerve impulses causing contraction of these muscles and so embarrassed breathing. Each lung is divided into large divisions or lobes, there being three lobes on the right side and two on the left. These lobes are quite distinct from each other, and into each enters a main branch of the right or left bronchus.

The lungs are more or less pyramidal in shape, the base of each pyramid lying on the diaphragm, and its apex lying behind and a little above the clavicle on each side.

The outer surface of each lung is rounded and lies in close contact with the thoracic wall.

The inner surfaces are slightly concave, and a little above the middle point of these surfaces the bronchi and pulmonary arteries enter the lungs and the pulmonary veins emerge from them. This point is called the *Hilus* of the lungs.

The space between the lungs is called the *Mediastinum*, and the most important structure lying there is the heart. This lies rather more to the left than to the right, and therefore encroaches more into the left lung than the right. Where the apex of the heart

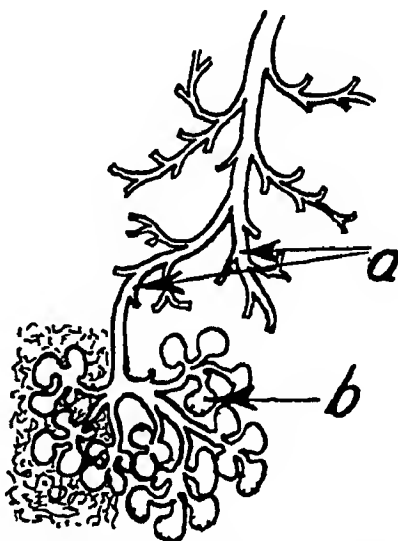


FIG 49 — DIAGRAM TO ILLUSTRATE THE MINUTE STRUCTURE OF LUNG TISSUE

The shaded portion indicates blood spaces by which the alveoli are surrounded  
a = Bronchioles      b = Alveoli

comes forward and lies immediately beneath the chest wall, there is a notch in the left lung to allow for this

Other important structures lying between the lungs are (1) Oesophagus, (2) Aorta and Aortic arch, (3) Superior Vena Cava.

**BORDERS OF THE LUNGS** There are two well-defined borders to each lung, namely, an anterior and posterior

The *Anterior Border* is thin and overlaps the heart in front,

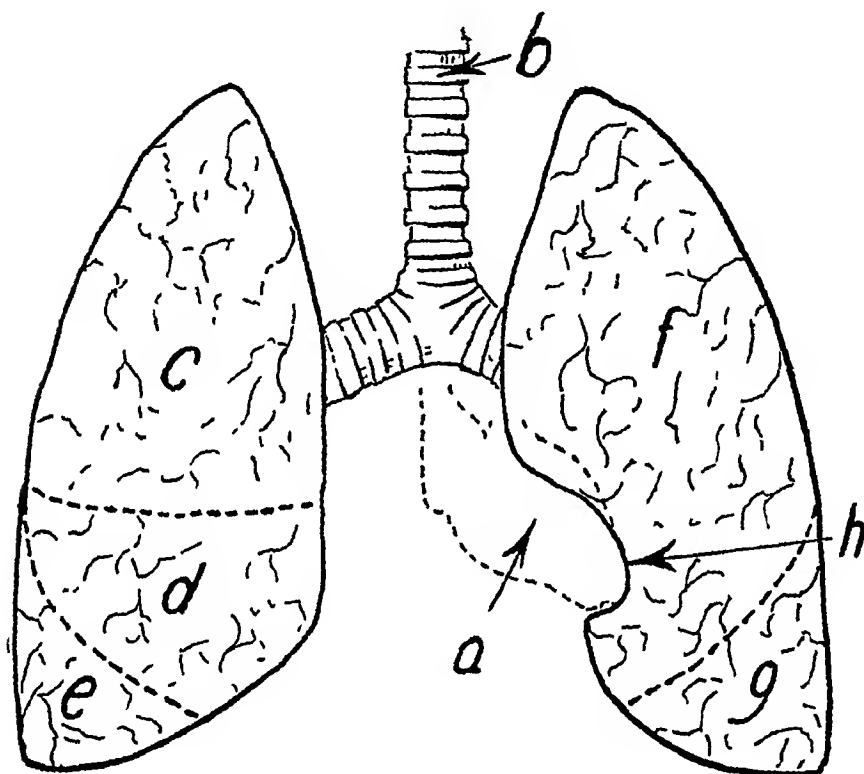


FIG 50 —THE LUNGS

These have been separated to show the position of the heart

- |  |  |
|--|--|
| a = Position of the heart                            | e = Lower lobe of the right lung                             |
| b = Trachea dividing below into the two main bronchi | f = Upper lobe of the left lung                              |
| c = Upper lobe of the right lung                     | g = Lower lobe of the left lung                              |
| d = Middle lobe of the right lung                    | h = Notch in the left lung occupied by the apex of the heart |

except at the extreme apex of that organ where the border of the left lung is notched, as stated above

The *Posterior Border* is rounded and lies in and fills the groove between the sides of the bodies of the vertebrae and the ribs

**BLOOD VESSELS OF THE LUNGS** There are two sets of arteries conveying blood to the lungs, namely the Pulmonary Arteries and the Bronchial Arteries

1 *Pulmonary Arteries* These contain venous blood and do not, therefore, take any part in the nourishment of the lungs. They are distributed by means of arterioles and capillaries to all the alveoli of the lungs, each alveolus being surrounded by a network of such capillaries. The blood in them is thus brought into intimate contact with the alveoli, and it is here that the interchange of carbon dioxide and oxygen takes place (*vide* "Physiology of the Respiratory System," Chapter XII)

2 *Bronchial Arteries* These are the nutrient vessels of the lungs. They come from the descending aorta and pass into the lungs at each hilus. They are distributed to the bronchi and bronchioles.

**VEINS** There are two sets of veins corresponding to the above arteries, passing out of the lungs at the hilus. The *Pulmonary Veins* contain oxygenated blood, being the only veins in the body that do so, and enter the left auricle.

The *Bronchial Veins* are very small and terminate in larger veins in the thorax (called *Azygos Veins*), which carry the blood to the innominate veins.

**PLEURA** This is a sheet of very smooth serous membrane which covers the lungs and lines the thoracic cavity. These two layers are called respectively the *Visceral* and *Parietal Layers*.

Normally there is a very thin film of fluid separating these two layers, and so enabling the lungs to move with a minimum of friction.

The parietal pleura does not line the whole of the thoracic cavity. If it is followed round the chest wall, it will be found to reach almost, but not quite, the middle line in front, and is then folded back so as to envelop the pericardium, and when it reaches the root of the lung (hilus) it is folded forwards and becomes continuous with the visceral pleura covering that lung.

This double folding occurs on both sides, so that there is a little gap just behind the middle of the sternum which is uncovered by pleura. This space is wider below, owing to the pleura on the left side being folded back sooner at the point where the notch in the lung for the apex of the heart is situated.

The pleura, in addition to covering the chest wall, also covers the diaphragm, where this is in contact with the lungs. This portion is called the *Diaphragmatic Pleura*.

## CHAPTER XII

### PHYSIOLOGY OF THE RESPIRATORY SYSTEM

THE main function of the lungs is to provide oxygen for the blood and to remove from it carbon dioxide. The supply of oxygen is obtained from the air, and is drawn into the lungs by the respiratory movements of the chest and abdomen.

The manner in which this is effected is as follows—

It will be remembered that the ribs are semicircular in shape, and are attached behind to the spinal column, which is the point of fixation where the “purchase” is obtained by the muscles in moving the ribs.

During inspiration the ribs are pulled upwards and outwards by the external intercostal muscles, and some of the muscles of the back. This enlarges the capacity of the thorax and, as the lungs lie close up against the thoracic wall without any intervening space, they are expanded with the chest wall. The cavity within the lungs is thus increased in size and is filled with air from the outside, through the bronchi and trachea.

In addition to the movement of the ribs, a very important movement of the diaphragm takes place. This is normally dome-shaped, and during inspiration this dome becomes flattened out by the contraction of the muscle fibres forming the diaphragm. This, therefore, still further increases the capacity of the lungs and so augments the thoracic movements in filling the lungs with air.

It should be observed that if the diaphragm becomes flattened it must push the abdominal contents downwards, and this is shown to occur by the protrusion of the abdominal wall, which is pushed forwards so as to make room for the viscera as they are so displaced.

The opposite occurs during expiration, when the chest cavity is diminished by the dropping of the ribs and by the pushing upwards of the diaphragm by contraction of the abdominal muscles. Air is thus expelled from the lungs.

There are thus two sets of respiratory movements, thoracic and abdominal

It is interesting to note that, generally speaking, the respiratory movements of the male show a greater tendency to be abdominal than in the female. This may be explained by the fact that were women to develop a habit of abdominal breathing, this would be seriously embarrassed during the period of child bearing

### Respiration Rate.

The normal respiration rate in adults is 15-18 per minute. It is more rapid in childhood (about 25 per minute)

Muscular activity increases the rate of respiration, and this is also increased in diseases of the lungs and in some forms of heart disease, particularly valvular disease

### Lung Capacity

In quiet breathing a man takes in about 500 c c of air at every inspiration and expires a like amount. In forced inspiration and expiration the amount is increased by another 1,500 c c. Further, it has been estimated that at the end of the most forcible expiration there is a residue of about 2,000 c c of air left in the lungs

That the lungs cannot be completely emptied of air is due to the fact that in a sense the lungs are too small for the chest cavity, even when this is reduced to its smallest capacity, and the lungs are, therefore, always kept somewhat "stretched"

That this is so is shown in cases where the chest wall is wounded. If under these circumstances air is allowed to enter between the lungs and the chest wall the lungs collapse away from the chest wall, owing to their elasticity. Such a condition is known as *Pneumo-thorax*

### Effect of Respiratory Movements on the Circulation.

From what has been said above, it will be easily understood that during inspiration the outward movement of the chest wall is opposed by the natural elasticity of the lungs. The result of the action of these two opposing forces is to tend to create a vacuum between the lung tissue and the chest wall. This causes distension of the veins in the thorax, and blood is thereby drawn into them from the larger veins in the thorax, abdomen, and neck



This suction action of the thoracic movement goes on continuously, and therefore plays an important part in assisting the flow of blood from the veins into the heart

The breathlessness, which is sometimes a distressing symptom of heart disease, is an effort on the part of nature to compensate for the feebleness of the heart's action by bringing into play the respiratory movements as an aid to the circulation

### Control of Respiratory Movements.

The movements of respiration are largely, but not completely, under voluntary control

They are under voluntary control in so far as the individual has power to stop them altogether or to increase them, but he cannot stop them for long, nor can he control their rate under all conditions, e.g. in muscular action. During the larger part of our existence we are unconscious of our respiratory movements, and this unconscious control is carried out by a nerve centre in the medulla of the brain

Many experiments have been carried out to determine how this nerve centre regulates the respiratory movements, and the result of these tends to show that the chief mechanism by which regulation is established is that afforded by the changes in the local blood supply conditions in the medulla, and by nervous impulses

Thus, the centre is stimulated by a *diminution* in the oxygen in the blood. As soon, therefore, as the tissues of the body have lowered the amount of oxygen in the blood below a certain point, the nerve centre is stimulated and respiratory movements are increased so as to restore the normal proportion of oxygen to the blood

The centre is also stimulated by an increase in the percentage of carbon dioxide in the blood

As, normally, the diminution in oxygen is accompanied by an increase in carbon dioxide, both these effects being the result of the normal activity of the cells of the body, the respiratory centre is doubly stimulated

That nervous impulses may affect the respiratory centre is clear from the well-known fact that the sensation of sudden cold may momentarily stop respiratory movements. Other sensations, e.g.

pain, also affect the respiration. Emotional disturbances (fear, anger, etc.), may also influence the respiration rate.

### Changes in the Air in the Lungs.

The essential changes that take place in the air in the lungs during normal respiration are loss of oxygen and increase in carbonic acid gas ( $\text{CO}_2$ ).

The normal gaseous composition of the air we breathe is—

Oxygen	20.95 per cent
Nitrogen	79.00 "
Carbon dioxide	0.05 "

Expired air from the lungs contains—

Oxygen	16 per cent
Nitrogen	79.00 "
Carbon dioxide	4.00 "

The above figures are approximate, and the percentages have been expressed thus for the sake of simplicity.

It must be remembered, however, that the volume of air expired is less than that inspired, as all the oxygen absorbed is not replaced by carbon dioxide. Some of it is used for oxidation of other elements than carbon, and does not, therefore, reappear in the expired air, but may be excreted in the urine, e.g. the oxidation of hydrogen to form water.

### Changes in the Blood in the Lungs.

The changes in the blood in the lungs are the exact opposite of those in the air, i.e. oxygen is absorbed and carbon dioxide expelled.

The chemistry of this process is very complicated and not perfectly understood, but the elementary facts are as follows—

Blood (*q.v.*) contains in its red cells a chemical substance, called haemoglobin, which has the power of loosely combining with oxygen to form a bright red substance, called oxy-haemoglobin. This combination is effected as the blood passes through the capillaries in the lungs, these capillaries closely surrounding the alveoli, and being separated from them by only two layers of cells, i.e. the wall of the capillary and the wall of the alveolus.

The carbon dioxide is contained almost entirely in the fluid

plasma of the blood, although a small proportion does become absorbed by the red cells. This carbon dioxide is in a state of partial solution and partial chemical combination, and when the blood reaches the lungs this carbon dioxide is given up and passes into the air in the lungs through the capillary and alveolar walls.

The actual process by which this is effected is very complicated, and depends upon rather intricate chemical and physical laws, which it is not necessary to describe in detail.

### Respiration in the Tissues.

Respiration in its widest sense means the interchange of gases between the individual and the atmosphere. The changes taking place in the lungs are the external signs of respiration, and were these the only changes, they would be useless.

It is not the blood that needs oxygen, but the tissues, and there is, therefore, an internal respiration which takes place in the tissues by which they obtain the oxygen from the blood, and discharge into it carbon dioxide and other products of their activity.

The haemoglobin, after it has given up its oxygen, is called "reduced haemoglobin."

As energy is obtained from coal or petrol by combustion, i.e. by oxidation, so the body obtains its energy by the oxidation of food material absorbed by the cell. This food material is obtained by absorption from the alimentary canal, and is oxidized in the cells of the body. The oxygen necessary for this is obtained from the blood.

The combination of oxygen and haemoglobin is so loose that the oxygen is readily given up to the cells, and, as oxidation occurs, the carbon dioxide formed accumulates until it becomes sufficiently concentrated to be forced out into the surrounding lymph spaces (*qv*) and so into the blood. This effect is in accordance with the well-known physical law that gases in solution, if brought into contact (separated only by a porous membrane) with a solution of less concentration, i.e. containing a lower percentage of gas, will pass through the intervening membrane until the concentration on each side is equal. This process is called *Osmosis*.

How muscular action affects the respiration can now be appreciated.

In the chapter on the *Physiology of Muscle*, the chemical changes that take place when a muscle contracts are described, and these are entirely due to oxidation. The formation of carbon dioxide as the end product in this oxidation, and of lactic acid as an intermediate product, is there described, and it is easy to see that the concentration of carbon dioxide in the lymph spaces round the muscle cells and so in the blood is increased, the greater the muscular activity.

This concentration in the blood affects the respiratory centres, as described above, and so increases the rate of respiration. The effect of this is that the carbon dioxide is rapidly expired, and oxygen taken in to supply the muscles with the necessary energy for their work.

This is the explanation of the fact that a man becomes "out of breath" if he indulges in abnormal muscular activity. When a man is "in training" his vital functions, (circulation and respiration) work, by training, so efficiently that distressing symptoms of circulatory or respiratory failure are postponed.

## CHAPTER XIII

### ANATOMY OF THE ALIMENTARY TRACT

THE Alimentary Tract starts at the lips and ends at the anal orifice. The teeth are one of the most important parts of this tract, but as they have been described in the first chapter, the reader is referred to the account given there.

The parts to be described in this chapter are the Tongue, Salivary glands, Pharynx, Oesophagus, Stomach, and Small and Large Intestines with their appendages.

#### General Structure of the Alimentary Canal.

The whole of the alimentary canal, from the stomach to the rectum, has the same general structure. It is primarily a muscular tube made up of involuntary muscle fibres, which are arranged in two chief layers, longitudinal and circular, the former being placed outside the latter. It is lined by mucous membrane, containing cells secreting mucus, but in the stomach and small intestine there are also numerous glands (tubular in shape) situated in the mucous membrane, and opening into the stomach or small intestine, as the case may be, and secreting digestive juices. In addition to these there are innumerable small projections covering the mucous membrane, termed "villi," whose function it is to absorb the nutritive parts of the food.

The small bowel is also characterized by a reduplication in folds of the mucous membrane, so as to increase the absorption area. These folds are known as *Valvulae Conniventes*. The bowel generally is covered by a serous coat (derived from the peritoneum), and in the small intestines (except the duodenum) and parts of the large intestines the serous coat completely covers the bowel, and is continued in the form of a double layer to the back of the abdominal wall to which it is attached, and so anchors the bowel. This sheet-like fold of peritoneum is known as the *Mesentery*.

Deviations from this normal structure are found in (1) the stomach, where the muscle wall is relatively thicker than in the

rest of the alimentary canal, and where the fibres are arranged obliquely as well as in a circular and longitudinal direction ; (2) the large bowel, where the longitudinal fibres are not arranged regularly to form a continuous layer, but are arranged in three bands, running the whole length of the bowel

## 1. Tongue.

This organ is formed entirely of muscle tissue. There are two groups of these, the *Intrinsic Muscles*, which are contained entirely within the tongue itself, and are attached to no bones, merely serving to alter the shape of the tongue by their contraction, and the *Extrinsic Muscles*, which are those by which the tongue is moved, and which arise from the hyoid bone, and from the lower edge of the back of the *Symphysis Mentis* (point of the chin) (See Fig 48)

The tongue is covered by a layer of tissue practically identical with the skin, but containing on its surface innumerable minute projections, called *Papillae*, in which are situated the terminations of the nerves of taste (taste buds)

The tongue occupies the whole of the floor of the mouth, and immediately behind it are the two openings of the larynx and oesophagus (the latter lying behind the former)

## 2. Salivary Glands.

These are four in number, two Submaxillary glands and two Parotid glands (See Fig 51)

(a) SUBMAXILLARY SALIVARY GLANDS. These are small glands, about the size of walnuts, lying immediately below and in front of the angle of the jaw (one on each side). They are almost completely covered by the jaw, and from the front and deeper part of the gland a duct passes forwards and opens in front of the floor of the mouth, just to the side of the tip of the tongue

(b) PAROTID GLANDS. These are two in number, one on each side, and are situated in the space between the lobe of the ear and the ascending portion of the lower jaw. Part of the gland projects forwards over the jaw, and a duct passes from this portion forwards over the *Masseter Muscle*, and then passes inwards to open into the mouth in the neighbourhood of the upper premolar teeth

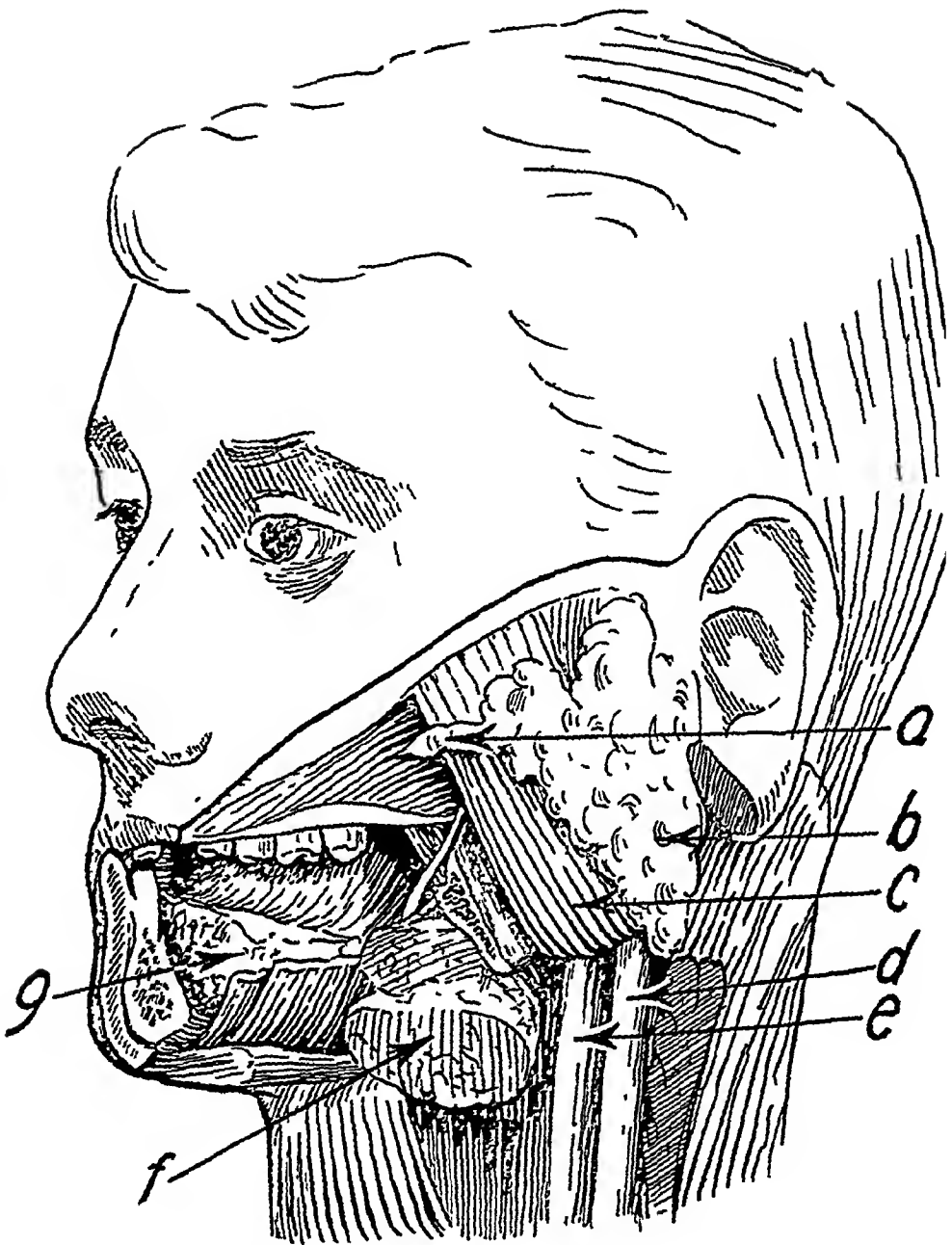


FIG 51 —DIAGRAM SHOWING SALIVARY GLANDS, ETC

- |  |   |
|--|---|
| a = Duct of the parotid gland (Stenson's duct) | d, e = Internal carotid artery and jugular vein |
| b = Parotid gland                              | f = Submaxillary salivary gland                 |
| c = Masseter muscle.                           | g = Sublingual salivary gland.                  |

### 3. Palate.

This is the division between the nose and naso-pharynx and the mouth. It consists of two parts, a bony, hard palate (derived from the superior maxilla (*q.v.*)) on each side between the nose and mouth; and a soft muscular portion extending downwards and

backwards from the back of the hard palate, and partially separating the cavity of the mouth from the naso-pharynx (See Fig 48)

On each side the soft palate is continued in two folds towards the side of the base of the tongue. These folds contain muscle, and are termed the *Pillars of the Fauces*. Between each pair of pillars (anterior and posterior on each side) lies the *Tonsil*. In the centre of the posterior margin of the soft palate is a small projection, the *Uvula*.

#### 4. Pharynx.

This is the upper part of the throat, lying immediately behind the mouth. It is funnel-shaped and is continuous below with the oesophagus, in front with the mouth and above with the naso-pharynx, or space behind the nose, from which it is separated by the soft palate. The walls of the pharynx are formed by a muscular sheet which, by its contraction, propels food down the oesophagus (See Fig 48)

#### 5. Oesophagus (Gullet).

This is a long tubular structure passing from the lower end of the pharynx down the neck, through the posterior part of the thorax, and terminating below, after passing through the diaphragm, in the stomach. Its walls are composed of muscular tissue (involuntary), and it is lined by mucous membrane. It lies behind the larynx, trachea, and heart.

#### 6. Stomach.

The stomach is situated immediately below the diaphragm, more to the left than the right-hand side. It is really a very much dilated portion of the alimentary canal, and is pear-shaped, with its broad or cardiac end to the left, and its narrow or pyloric end to the right. The oesophagus joins the stomach a little to the right side of the larger end. There is thus an anterior and posterior surface of the stomach, and a superior and inferior border, the former being shorter than the latter. The two borders are usually referred to as the *Greater* (inferior), and *Lesser* (superior) *Curvature*. The stomach ends at its narrow extremity, in an orifice leading to the first part of the small intestine, called the *Duodenum*. This



orifice is surrounded by circular muscle fibres (the *Pylorus*) which can shut off completely the stomach from the duodenum

The stomach is closely apposed in front to the left lobe of the liver, the anterior abdominal wall, and the diaphragm, and behind

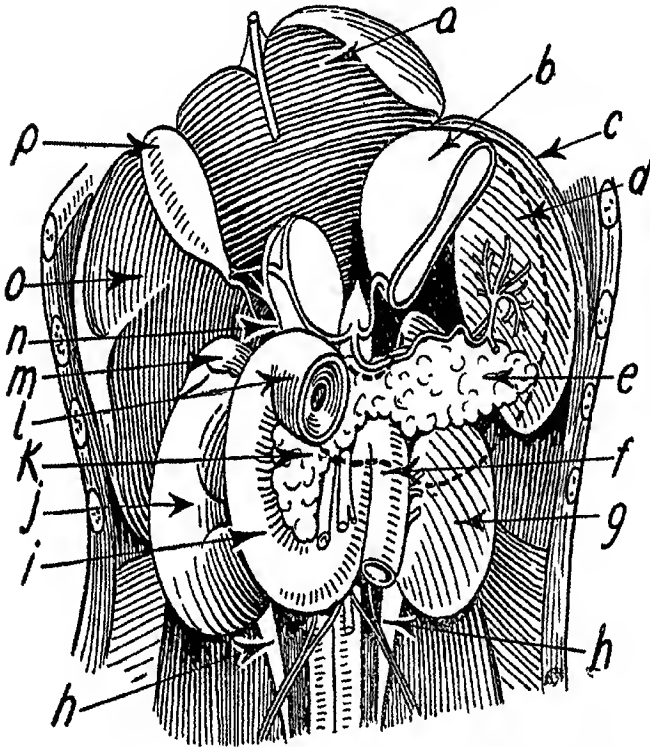


FIG 52.—DIAGRAM SHOWING THE CONTENTS OF THE UPPER PART OF THE ABDOMEN

With most of the stomach removed (the part removed shown by the dotted line)  
The liver is pulled up to show its under surface

- |  |  |
|--|--|
| a = Left lobe of the liver (under surface) | j = Right kidney                             |
| b = Fundus or cardiac end of stomach       | h = Head of the pancreas                     |
| c = Left dome of the diaphragm             | l = Pyloric end of the stomach (cut across)  |
| d = Spleen                                 | m = Right suprarenal gland                   |
| e = Tail of the pancreas                   | n = Junction of the common bile duct and     |
| f = Duodeno jejunal flexure                | cystic duct (from gall bladder)              |
| g = Left kidney                            | o = Under surface of right lobe of the liver |
| h = Ureters                                | p = Gall bladder                             |
| i = Duodenum                               |  |

to the spleen, pancreas, the upper part of the left kidney, and suprarenal gland, and the diaphragm

## 7. Small Intestine.

(a) **DUODENUM** This is the first part of the small intestine, and is about 12 in in length. It is closely attached to the posterior

abdominal wall and forms two-thirds of a circle, passing at first a little backwards and to the right, then downwards, then across to the left, and then upwards, where it ends in a sudden forward bend (the *Duodeno-jejunal Flexure*) and becomes continuous with the second part of the small intestine (the *Jejunum*). The most important portion of the duodenum is the second part (descending) into which the duct from the liver (*Common Bile Duct*) and the duct from the pancreas (*Pancreatic Duct*) open.

(b) **JEJUNUM** This, with the *Ileum* (with which it is continuous), forms the larger part of the intestinal canal, and measures about 8 ft. in length, the ileum being 12 ft. long.

These two sections of the bowel are indistinguishable externally, and it is only when the interior is examined, that small differences are found. It is unnecessary here to enumerate these.

The whole of the small bowel (from its commencement at the duodeno-jejunal flexure to its termination at the ileo-caecal valve) is attached to the posterior abdominal wall by a double sheet of peritoneum, called the *Mesentery*, which, while anchoring the bowel, enables it to arrange itself into coils, and to allow food to pass along more freely.

(c) **ILEUM** (*vide supra*) The ileum ends below in the right iliac region (lower right side of the abdomen), or, as it is usually called, the *Right Iliac Fossa*, where it opens into the first part of the large intestine (the *Caecum*). The opening is at the side of the Caecum, and is surrounded by a thickening of the muscular coat of the bowel. This opening is called the *Ileo-caecal Valve*, and prevents regurgitation of the contents of the large bowel into the ileum. (See Fig. 54.)

## 8. Large Intestine, or Colon and Rectum.

The large bowel is divided into six parts, viz : (1) The Caecum, (2) Ascending Colon, (3) Transverse Colon, (4) Descending Colon, (5) Sigmoid, (6) Rectum.

The general course of the bowel is from the right iliac fossa up to the right lobe of the liver and right kidney (*Ascending Colon*) ; then across the abdomen to the spleen, on the left side (*Transverse Colon*) , thence downwards to the left iliac fossa (*Descending Colon*) . Here the large bowel becomes more free, and becomes arranged in one or two coils (the *Sigmoid Colon*) until it reaches the front of the

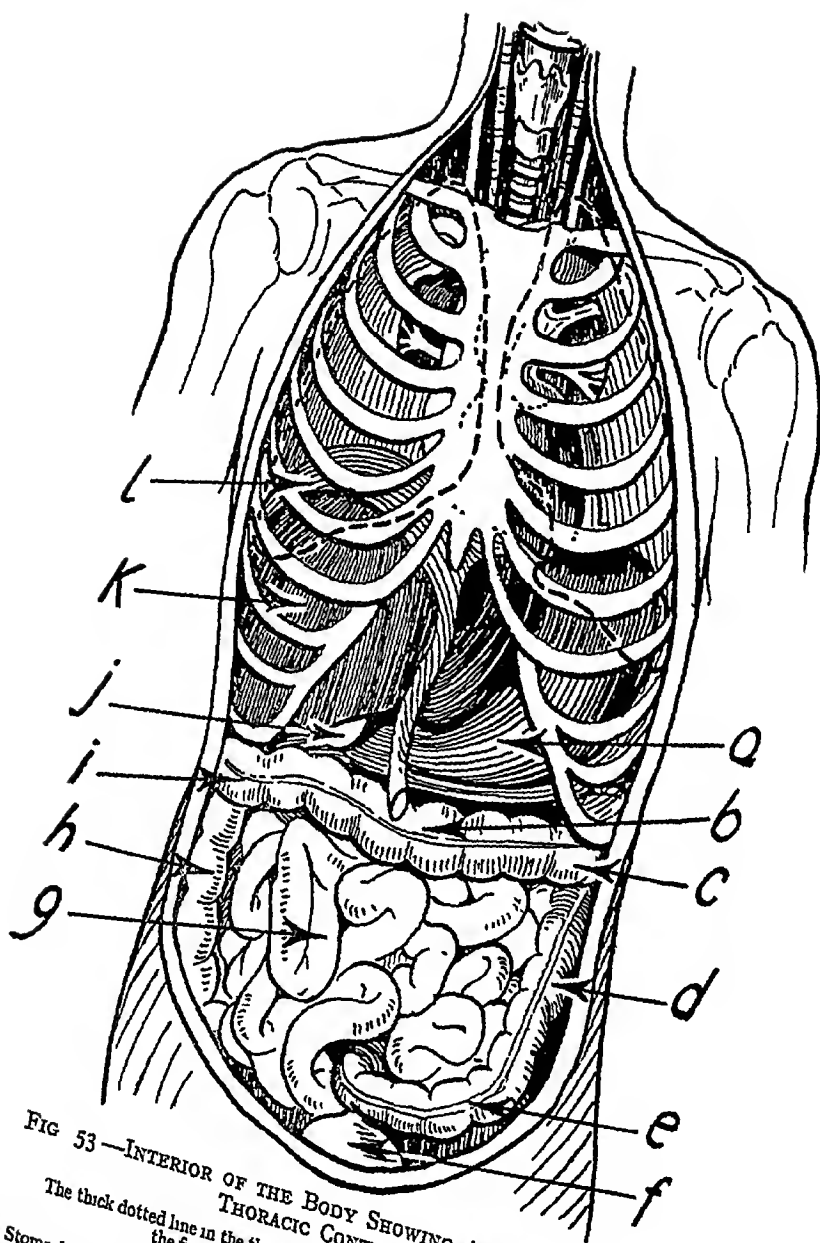


FIG 53—INTERIOR OF THE BODY SHOWING ABDOMINAL AND THORACIC CONTENTS

- The thick dotted line in the thorax represents the outline of the lungs, and the fine dotted line the outline of the heart
- a* = Stomach
  - b* = Transverse colon
  - c* = Splenic flexure of the colon
  - d* = Descending colon
  - e* = Sigmoid flexure of colon
  - f* = Bladder
  - g* = Coils of small intestine
  - h* = Ascending colon
  - i* = Hepatic flexure of colon
  - j* = Tip of gall bladder
  - k* = Liver
  - l* = Right dome of diaphragm

sacrum, where it passes downwards as the *Rectum*, and ends in the *Anal Orifice*

The large bowel differs from the small in several particulars (1) in its greater diameter, (2) in that it is in most of its course (except the transverse colon and sigmoid flexure) in close apposition with the posterior abdominal wall, (3) it has a sacculated appearance, and the longitudinal muscle fibres are arranged in three separate bands, and not spread uniformly over its surface

1 THE CAECUM is the blind lower end of the ascending colon, and its chief interest lies in the attachment to it of the vermiform appendix

*Vermiform Appendix* This is a worm-like process attached to the inner side of the caecum, just below the ileo-caecal valve. It is hollow, and its structure is

like that of a minute piece of bowel, being lined by mucous membrane, and the walls formed of muscular tissue. It varies greatly in length, from 1-5 or 6 in.

2 ASCENDING COLON This runs vertically upwards to the under surface of the right lobe of the liver, where it bends inwards and downwards, forming the *Hepatic Flexure*, and is then named the transverse colon

3 TRANSVERSE COLON This is a comparatively loose part of

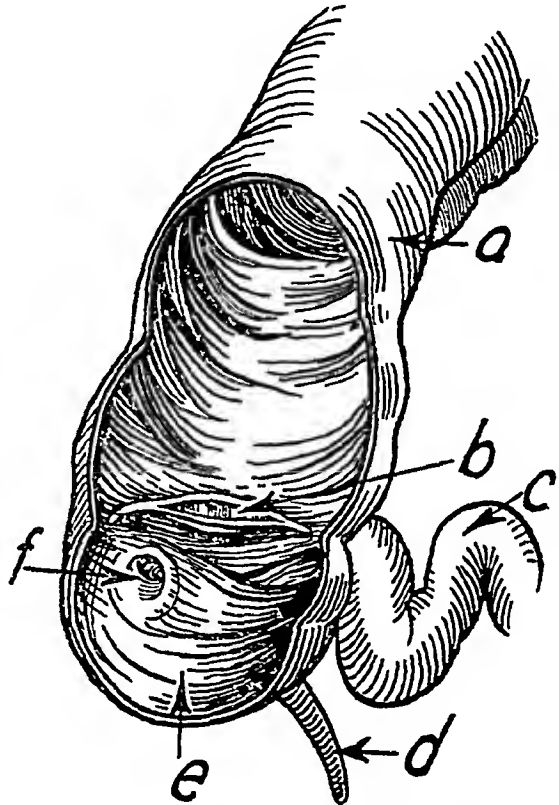


FIG 54.—DIAGRAM OF INTERIOR OF THE CAECUM

a = Ascending colon	d = Appendix
b = Ileo caecal valve	e = Blind end of the caecum
c = Ileum.	f = Opening of the appendix

the large bowel, and though normally confined to the upper part of the abdomen, may, and frequently does, drop downwards, forming a large curve and terminating in the left side, near the spleen, in the *Splenic Flexure*, which is the name given to the rather sharp angular curve it makes, as it starts passing down the left side of the abdomen as the descending colon.

4 DESCENDING COLON. This terminates below in the left iliac fossa. It is closely attached to the posterior abdominal wall, and at its termination comes forwards and develops a mesentery. This part of the bowel is called the sigmoid colon.

5 SIGMOID COLON. This is a more tortuous part of the large bowel, lying partly in the left iliac fossa and partly in the pelvis. It ends in front of the sacrum by turning vertically downwards, the bowel from this point onwards being called the rectum.

6 RECTUM. This is the terminal portion of the large bowel, and descends in front of the sacrum with two slight lateral curves, until it reaches just below the tip of the coccyx, where it turns backwards, narrowing very considerably, and ends in the anal orifice.

### The Liver.

The liver is a large organ of brown colour lying in the upper part of the abdomen, chiefly on the right side, but extending across to the left. It is roughly pyramidal in shape, and is divided into two lobes, right and left. The right lobe is by far the larger of the two, and lies on the right side, immediately below the diaphragm, and extending downwards as far as the lower border of the ribs.

The left lobe is also in contact with the diaphragm on the left side, but tapers towards a pointed extremity in the neighbourhood of the spleen.

The liver, as seen from the front, therefore, is triangular in shape, with its base towards the right and its apex to the left, the lower border passing obliquely upwards and to the left, across the front of the abdomen.

The whole of the upper surface of the liver is in apposition with the diaphragm, whereas its lower surface comes in contact with the stomach on the left side; and the right kidney, hepatic flexure of the colon, and first part of the duodenum, on the right side.

The liver, being a glandular organ, is supplied with ducts for the passage of bile into the alimentary canal. These ducts are two in number, the right and left ducts draining the right and left lobes

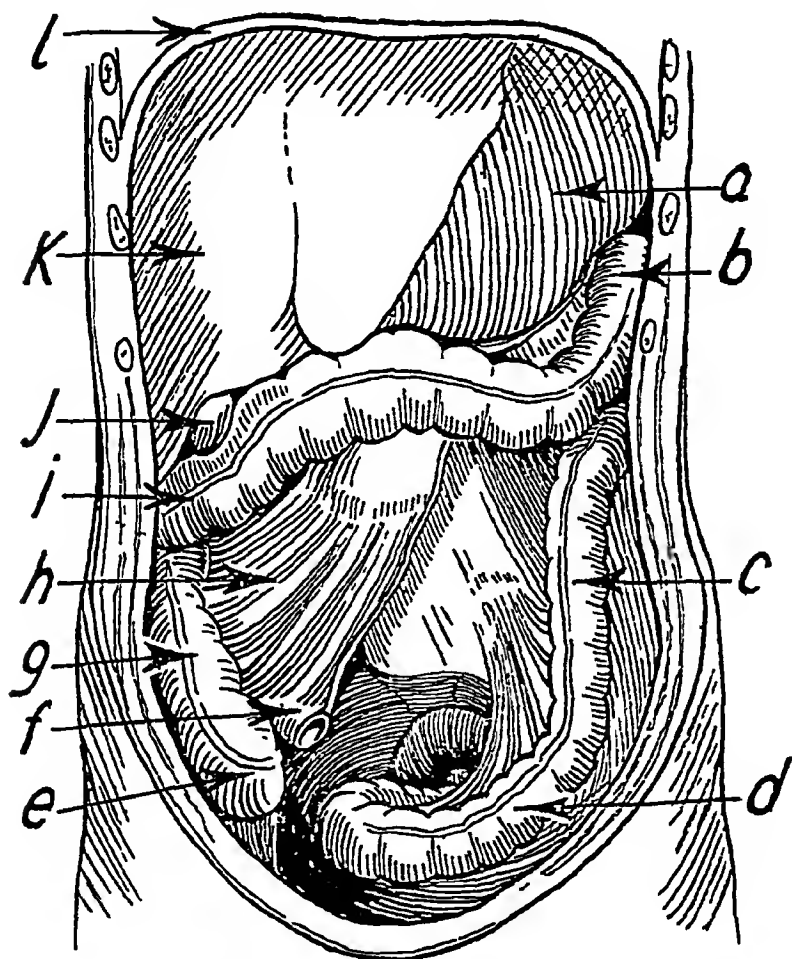


FIG 55—DIAGRAM OF ABDOMINAL CONTENTS AFTER REMOVAL OF THE SMALL BOWEL

- |   |  |
|---|--|
| a = Stomach                                       | g = Ascending colon                          |
| b = Splenic flexure of colon                      | h = Peritoneum forming part of the mesentery |
| c = Descending colon                              | i = Hepatic flexure of colon                 |
| d = Sigmoid flexure                               | j = Gall bladder                             |
| e = Caecum  | k = Liver                                    |
| f = Cut end of small intestine leading to caecum. | l = Diaphragm.                               |

of the liver respectively. These unite into one hepatic duct, which passes downwards until it is joined by the duct from the gall bladder (*Cystic Duct*). From this point it is known as the *Common Bile Duct*, and passes downwards to open into the second part of the duodenum.

**GALL BLADDER** This is the receptacle for the bile, storing this until it is wanted in the bowel. It is a small oval-shaped sac, about 3 to 4 in long and 1 in wide, lying on the under surface of the liver, and holds about an ounce of fluid. It tapers at one end, where it becomes continuous with a small duct, the cystic duct, which joins the hepatic duct and so forms the common bile duct. The gall bladder in its normal position hangs somewhat downwards, the blind end (*Fundus*) pointing downwards and forwards. Its wall consists of involuntary muscular tissue, and it is lined by mucous membrane. (See Figs 52 and 53.)

**COMMON BILE DUCT** This is formed by the union of the hepatic and cystic ducts, and passes downwards behind the first part of the duodenum, and then enters the wall of the second part of the duodenum somewhat obliquely on its inner side. The internal opening in the duodenum is common to it and the pancreatic duct.

**PANCREAS (SWEET BREAD)** This is an elongated gland lying transversely across the posterior abdominal wall, behind the stomach. It has an expanded "head" on the right side, which lies in the curve formed by the duodenum. The left extremity, or tail, lies just touching the spleen.

The main body of the gland is about 1 in in diameter. A duct passes along the body of the gland towards the right, draining its secretion, and is joined near the head of the gland by another small duct. These two either combine to form one main duct which passes to the second part of the duodenum, or else they may open into the bowel independently.

It is usual for the main duct to join the common bile duct immediately before it opens into the duodenum. The most important structures in apposition with the pancreas are the stomach in front, the duodenum enclosing the head, and the spleen in contact with the tail. (See Fig 52.)

## CHAPTER XIV

### PHYSIOLOGY OF THE ALIMENTARY TRACT

THE whole object of the alimentary canal is to extract from the food the nutritive material required by the body to maintain its growth and activities. It will be readily understood that the food of man consists of an immense variety of substances, some of which are of no nutritive value at all, and none of which, except water, can be absorbed directly into the circulation.

It therefore follows that an apparatus has to be provided to prepare the food material in such a way as to convert unabsorbable into absorbable products (this is called *Digestion*), absorb the useful material so prepared (this is called *Absorption*), and remove the useless material (*Excretion*).

Digestion is carried out in the stomach and upper part of the small intestine, absorption, in the small intestine and (chiefly water) in the large bowel, excretion is the primary function of the large bowel.

In order that digestion may take place in the stomach, the food has to be prepared for this process, and this is done by mastication in the mouth and the mixing of the food with the saliva.

There are thus four processes carried out by the alimentary canal, namely *Mastication*, *Digestion*, *Absorption*, and *Excretion*.

In order to understand, even approximately, the various processes undergone by the food, it is necessary to enter into a little detail of the chemical composition of the ordinary food materials taken into the body.

The chief food materials utilized by the body are—

- |                  |         |
|------------------|---------|
| 1 Protein        | 4 Salts |
| 2 Carbo-hydrates | 5 Water |
| 3 Fat            |         |

Nos 4 and 5 have no energizing or directly nutritive value, but they are of great importance in providing the body with a fluid



medium, in which the normal activities of the cells can be performed. As every living cell must be bathed in fluid of the correct reaction and density, the great importance of the proper absorption of water and salts, wherefrom this medium is obtained, is obvious.

Water and salts are also of importance in the chemical reactions that take place during digestion and absorption. They have, however, no energy that can be utilized by the body, and, therefore, are not regarded primarily as foods.

**VITAMINES** Recent experiments in nutrition have shown that in addition to the above-mentioned food materials, there are other important elements which must be present in food in order that the body may be maintained in health. The exact nature of these elements is unknown. They have been termed "Vitamines," and their most important effects are that they assist in the assimilation of food material, aid growth, and prevent such diseases as Scurvy and Rickets. The food materials in which vitamins are chiefly found are in fats and fresh fruit and vegetables. The vitamins are largely destroyed by cooking.

## 1. Protein.

This is the chief source of supply of nitrogenous material which is essential for the growth of the body cells. Protein is the name given to the composite albuminous and, therefore, nitrogenous matter forming the basis of the living cell, but it is a mixture of many different kinds of albumens and allied substances.

The protein of one animal differs from that of every other, and it would, therefore, be useless for the body to absorb a "foreign" proteid, i.e. one derived from the flesh of another, or even from a plant, unchanged. It must first be broken down into simpler products, and these absorbed and subsequently utilized to build up the protein peculiar to the individual.

The simpler products into which the protein is broken are all nitrogenous, and are known as *Amino-Acids*. The process of breaking down the protein molecule into these end-products takes place in two stages—

1. In the stomach, where the gastric juice converts the protein into simpler intermediate products, called *Peptones*. This process

is effected by the action of a "ferment,"<sup>1</sup> called *pepsin*, contained in the gastric juice

2 In the small intestine, where the peptones are converted into amino-acids by the secretion of the *Pancreas*, this process being effected by the ferment in the pancreatic juice, called *Trypsin*

UREA Some of the amino-acids so formed are not utilized by the body, but are broken down still further into the nitrogen containing body called *Urea*, which is excreted by the kidneys This substance is formed in the liver from the broken-down products of the absorbed protein, and also of the protein of the tissue cells which are broken down during the activity of the tissues The greater portion of the urea from the body cells is derived from muscular tissue during active muscular exercise

URIC ACID This is another product of the breakdown of the protein molecule It is derived both from the food and from the activity of the living cells (chiefly muscular) Some of it is excreted unchanged by the kidneys, and the rest is converted into urea and excreted as such in the urine

## 2. Carbohydrates.

Starch and sugar are the chief foods consisting of carbohydrates They contain carbon, hydrogen, and oxygen, and are the chief source of the *heat energy* of the body This means that when they are digested and absorbed they are oxydized in the tissues to form water and carbonic acid gas, and the heat liberated in the process serves as the chief source whereby the warmth of the body is maintained They also supply the energy necessary for the muscles when they contract

The third important use they perform is in the formation of fat. This does not mean that normally fat is formed from carbohydrate food, but if excess is taken it may be so converted.

The digestion of carbohydrate foods starts in the mouth, where they are mixed with the saliva The saliva contains a ferment, *Ptyalin*, the effect of which is to convert starch into sugar

This process is continued in the stomach, but the gastric juice

<sup>1</sup> A *Ferment* is a substance which excites a chemical change without in itself being changed As a rule, each ferment can affect only one form of material, e g one can convert starch into sugar, another fat into glycerine and fatty acids, etc

does not contain any ferment in itself capable of effecting the conversion of starch into sugar, and the gastric digestion of carbohydrates is, therefore, merely a continuation of the action of the ptyalin swallowed with the food

In the intestines the sugar and starch undigested by the ptyalin is mixed with the pancreatic secretion which contains a ferment, *Amylase*, which completes the conversion of starch into sugar

The sugar taken with the food is not absorbed as such, but has to be converted into a special absorbable form of sugar, called *Dextrose*, and this is the end product of the digestion of all the starch and sugar taken in the food. The ptyalin and amylase act on the sugar of the food, as well as the starch, and there is in addition, a ferment produced by the mucous membrane of the small intestine, which assists in the process

The dextrose, when absorbed, passes straight into the blood, and is carried by the portal system to the liver. It is there converted into a substance called *Glycogen*, and stored until required by the body. The amount of sugar circulating normally in the blood for the body's needs is thus kept constant (about 0.15 per cent). If a very large amount of starch and sugar is taken in the food, the liver may not be able to convert it all, and store it as *Glycogen*, and in these circumstances it is excreted unchanged (as dextrose) in the urine. This is a condition known as *Alimentary Glycosuria*, and must not be confused with true *Diabetes*, which is a disease in which, owing to abnormal pancreatic digestion, the sugar is not made available for the liver, and is excreted in its entirety, or nearly so.

The end products of the breakdown of starch and sugar by the body are water and carbonic acid. The former is excreted by the kidneys, and the latter partly in the urine in the form of the corresponding salt (carbonates) and partly in the lungs (see "*Respiration*," Chapter XII)

### 3. Fats.

The fats taken in the food are different in chemical structure from those found in the living body, but the exact process by which the one is converted into the other, or, indeed, to what extent the fat of the living individual is derived from the fat of the food,

is not accurately known. Certain facts are, however, well established.

The pancreatic secretion contains a ferment called *Lipase*, which can convert fats into glycerine and fatty acids. The pancreatic juice also causes emulsification of the fat, i.e. causes it to split up (mechanically) into minute droplets, which do not, when once formed, coalesce again. This is effected by the formation of soap from the fatty acids by combination of these with alkaline salts present in the intestine. This emulsification enables the lipase to reach the fat more quickly, and the whole is gradually converted into glycerine and fatty acids. These are then absorbed by the small intestine, which is lined by innumerable minute fingerlike processes, called *Villi*, richly supplied with blood and lymph spaces, and it is through these villi that absorption of all food products take place. When the glycerine and fatty acids have been absorbed, they are re-combined, probably in different proportions, so as to form the fat suitable for the individual. The fat is then absorbed into the lymph spaces of the villi, and carried by the lymphatics to the thoracic duct by which it is conveyed into the circulation.

It must be mentioned here that the bile has a most important part to play in the digestion of fat. It assists the pancreatic juice in the digestion of fat by accelerating the splitting up of the fat into fatty acids and glycerine, and it also, by means of the bile salts, dissolves the fats and fatty acids and so assists in their absorption.

Having given a brief description of the digestion and absorption of the ordinary food materials, it might be useful to add a table showing the stages of digestion at different points and the function of the various digestive glands—

1 MOUTH *Mastication*—Conversion of starch into sugar by the ferment *ptyalin*

2 STOMACH *Digestion*—Conversion of starch into sugar by *ptyalin* (continued)

Conversion of protein into peptones by the ferment *pepsin*

Coagulation of milk by ferment *Rennin*, whereby it is made more digestible

Reaction of gastric juice, normally acid. This is essential for the efficient action of the ferments

3 SMALL INTESTINE *Digestion and Absorption*—Conversion of peptones into amino-acids by *trypsin* (in pancreatic juice)

Conversion of fat into glycerine and fatty acids by bile and a ferment *lipase* (from pancreas)

Conversion of starch into dextrose by the ferment amylase (pancreas)

Absorption of all these products by the villi of the intestine

4 LIVER Conversion of dextrose into glycogen and its storage until required

Formation of bile (assists in absorption of fats)

5 PANCREAS Digestion of proteins, carbohydrates, and fats

Conversion of peptones into amino-acids (trypsin), starch to dextrose (amylase), fat to fatty acids and glycerine (lipase)

6 GASTRIC JUICE—*Composition*—Specific gravity, 1.0025

Contains ferments (pepsin and rennin), hydrochloric acid (3 per cent,) water, inorganic salts

7 BILE *Composition*—Water, 97 per cent, bile salts, 1 per cent, mineral salts, 1 per cent, mucin and pigment, 1 per cent

These figures are only approximate, and in addition to the substances mentioned, there is an important one *Cholesterin*, the function of which is not known. It is one of the chief constituents of gall stones

### Passage of Food along the Alimentary Canal.

This is effected by means of contraction in the musculature of the alimentary canal. These contracting waves pass regularly along the whole alimentary canal, and are called *Peristaltic Waves*, the whole movement being called *Peristalsis*. The way in which these waves are produced is not known, but it is known that—

1. They are excited into special activity if the stomach is distended with food

2. They are dependent upon the integrity of the nerves of the intestines.

3. They are entirely out of control of the voluntary nervous system

Their function is twofold, viz, to churn up the contents of the bowel so that the digestive juices may have the maximum effect; and, secondly, to pass the intestinal contents along the canal

There are two parts of the alimentary canal where the contents are normally retained for some considerable time—

1. The stomach.

2. The large intestine

The food is normally held in the stomach for from two to three hours, according to the nature of the food. It is prevented from passing into the small intestine by the closure (by contraction of circular muscle fibres) of the narrow passage (the pylorus) leading from the stomach to the duodenum.

While the food is thus kept in the stomach, it is churned up by the peristaltic waves of the stomach wall, and the pylorus opens

and allows the food to pass on at irregular intervals and in small quantities, so that the stomach may not be emptied of a meal for two to three hours

The contents of the large bowel are retained normally until their original liquid form has taken on a semi-solid consistency, owing to absorption of water. The contents pass on slowly along the bowel until the rectum is reached, where they are retained until the bowels are open (*Defaecation*)

By examination under the X-rays, it has been shown that the normal time for the contents to pass from the stomach to the rectum is about 32 hours. They are then generally retained for another 12 to 24 hours

## CHAPTER XV

### ANATOMY OF THE GENITO-URINARY SYSTEM

THE Genito-urinary system consists of the excretory organs, viz. kidneys, ureters, bladder, and urethra, and the generative organs, male and female

#### Kidneys.

These are two in number, and are situated on the posterior abdominal wall, behind the liver, on the right side, and the spleen on the left. Each kidney is about  $4\frac{1}{2}$  in long and 2 in broad. The convex border lies to the outer side and the concave inner border has projections from it, called *Papillae*, which open into the pelvis of the kidney.

The pelvis is a space enclosed by a fibrous layer, lined by epithelium, somewhat triangular in shape, the base of which is formed by the kidney (inner border) and the apex opens into the ureter.

If the kidney is cut across longitudinally, two well-marked areas are visible, one an outer zone, the *Cortex*, dark in colour, and an inner medullary part, pale in colour.

The blood vessels (renal artery and vein) pass to and from the kidney, in front of the ureter.

The front of the right kidney is in apposition with the liver, hepatic flexure of the colon and the duodenum.

The front of the left kidney is in apposition with the stomach, pancreas, and splenic flexure of the colon.

#### Suprarenal Glands (or Adrenal Glands).

These are two ductless glands, one situated at the upper pole of each kidney, and resting on it, as it were, like a cap. There is no duct leading from these glands, but it secretes a substance (*Adrenalin*) which is absorbed into the blood stream.

## Ureters.

These pass from the pelvis of the kidney to the bladder. They are about a quarter of an inch in diameter, and lie against the muscles of the posterior abdominal wall. As they pass downwards they come forwards and enter the bladder at its base, passing for about 1 in. obliquely through the bladder wall.

## Bladder.

This is a muscular organ, globular in shape when full (it holds, when normally distended, about  $1\frac{1}{2}$  pints). It is situated in the pelvis, immediately behind the pubic bones. It is lined by mucous membrane and covered over its upper surface by peritoneum.

It has three orifices opening into it. These are situated at the base of the organ and are arranged in a triangle. The area between these openings is called the *Trigone* of the bladder, and its apex points forwards. The orifice at the apex is the bladder-opening of the urethra, and the two others, at the base of the triangle, are the openings of the ureters (right and left).

In the male the neck of the bladder (i.e. the part from which the urethra starts) is surrounded by the prostate gland, and from

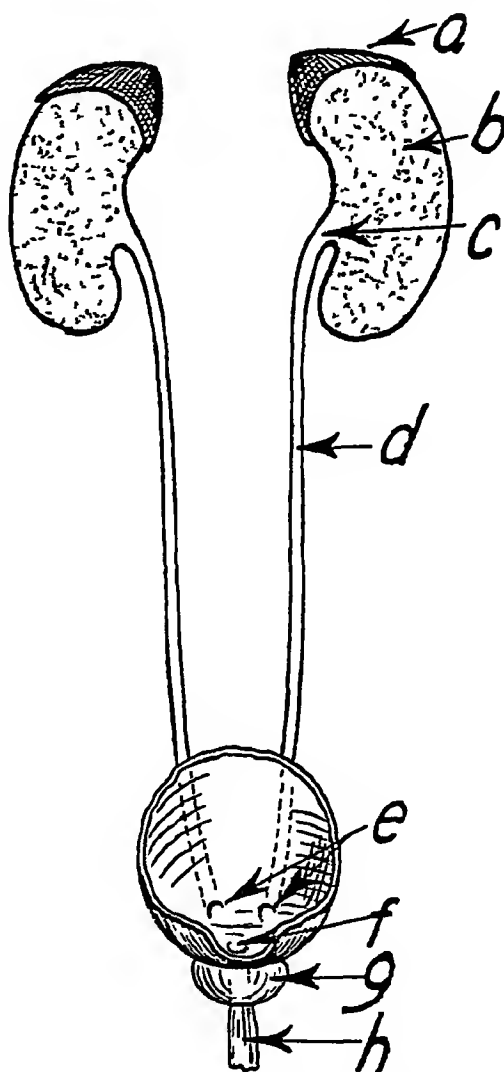


FIG 56—DIAGRAM OF KIDNEYS, URETERS, BLADDER AND URETHRA IN THE MALE

- a* = Suprarenal capsule
- b* = Kidney
- c* = Pelvis of the kidney
- d* = Ureter
- e* = Opening of ureters in the bladder
- f* = Opening of the urethra in the bladder
- g* = Prostate gland
- h* = Urethra



thus the two *Vesiculae Seminales* extend backwards and upwards over the base of the bladder. Behind the bladder lies the rectum.

In the female the uterus lies immediately behind the bladder, between it and the rectum.

### Urethra.

In the male this passes through the prostate gland, beneath the pubic arch and along the penis.

In the female it is very short, and opens just above and in front of the vagina.

### Genital Organs.

**MALE** The essential organs of reproduction in the male are the testicles, prostate gland, and seminal vesicles.

*Prostate* This is a gland situated at the base of the bladder, shaped like a chestnut. It surrounds the first part of the urethra. Its secretion passes into the urethra. The spermatic ducts pass through its substance to open into the urethra.

*Seminal Vesicles* These are two elongated pouches which extend upwards from the groove between the prostate and back of the base of the bladder. The lower ends of the vesicles pass downwards, and open into the spermatic ducts just before these enter the prostate.

*Testicles* These are two oval-shaped glands, which secrete the semen. Along the posterior border, and over the upper pole of each testicle lies the *epididymis*, which is a mass of convoluted tubules leading from the testicle to the spermatic duct.

*Spermatic Duct (Vas Deferens)* This is the duct which conveys the secretion of the testicle to the prostate gland and seminal vesicles. It runs up from the lower end of the epididymis, through the external abdominal ring, along the inguinal canal, and so into the pelvis, where it curves downwards and inwards to pass through the prostate. The ducts of the seminal vesicles open into the spermatic ducts just before they enter the prostate gland. These then open into the urethra.

**FEMALE** The essential female organs of reproduction are the Ovaries and Uterus, with its appendages, the *Fallopian Tubes*.

*The Ovaries* These are two in number Each one is about the size of a walnut, and lies near the brim of the pelvis on each side

*Uterus.* This is a pear-shaped organ, the apex of which points downwards and forwards, opening into the vagina (genital passage) Above it is about 2 in broad, and from each angle of the upper broadened extremity passes a tube (the *Fallopian Tube*) These tubes pass outwards and each ends near the corresponding ovary in an expanded funnel-shaped extremity Within the uterus is a narrow cavity opening below in the vagina and above communicating with each Fallopian tube

## CHAPTER XVI

### PHYSIOLOGY OF THE GENITO-URINARY SYSTEM

THE function of the kidney is to excrete the urine, which passes down the ureters to the bladder, where it is stored until evacuated through the urethra

#### Urine.

The composition of normal urine varies a good deal according to the food taken, time of year, and general habits of the patient, but the following is a list of the substances normally and usually found in the urine. It is slightly acid in reaction, and contains—

- |   |   |                                |
|---|---|--------------------------------|
| 1 | Water                                   |                                |
| 2 | Urea                                    |                                |
| 3 | Uric acid                               |                                |
| 4 | Urates (salts of uric acid)             | } Nos 2-5 all contain nitrogen |
| 5 | Creatin                                 |                                |
| 6 | Phosphates (salts of phosphoric acid)   |                                |
| 7 | Oxalates (salts of oxalic acid)         |                                |
| 8 | Sulphates (salts of sulphuric acid)     |                                |
| 9 | Carbonates (salts of carbonic acid gas) |                                |

There are many other substances frequently found in normal urine, but the above are the most important

The nitrogenous substances, urea, uric acid, urates, and creatin, are the end products of the changes undergone by protein food taken by the mouth, and also are the products of the breaking up of the cells of the body during their activity

Urine is normally an amber coloured, clear liquid, with a specific gravity of about 1.020 (water being 1.000). About 1,500 c.c. are secreted daily, containing 33 grams of urea, the remaining nitrogenous substances in the urine amounting only to about 2 grams

**SECRETION OF URINE** The kidneys are formed of a mass of tubules, those in or near the cortex being very much twisted (convoluted), and brought into extremely close contact with the blood vessels. The tubules are formed of a single layer of cells which intimately surround the blood capillaries, forming little

bunches of tubules and capillaries, called *Glomeruli*. It is probably here that the fluid of the urine is chiefly secreted. The convoluted tubules then pass towards the medullary portion of the kidney, and there join long, straight tubules, which open into the renal pelvis. It is generally accepted that the solid substances dissolved in the urine are secreted by this part of the tubules.

**FACTORS AFFECTING THE NORMAL SECRETION OF URINE** The function of the kidneys being to remove waste products from the blood and, if necessary, by removal of excess of fluid, to restore the normal fluid consistency of the blood, if this for any reason has become abnormally diluted, it is to be expected, and indeed is a fact, that the secretion of urine is primarily affected by alteration in the composition of the blood flowing through the kidney. Thus, any excess of waste products, e.g. urea, uric acid, etc., that may be in the blood, stimulates the kidneys to increased activity in order that these unwanted and harmful products may be reduced to normal proportions. Thus, the taking of food without the necessary amount of fluid will result in a relatively small amount of urine, concentrated, and of higher specific gravity than normal.

On the other hand, if the blood is diluted by the taking of excessive amounts of fluid, the urine will be increased in quantity and of low specific gravity, owing to the activity of the renal cells in extracting the water from the blood.

**Seasonal Fluctuations** In hot weather the urine is concentrated and relatively small in amount, owing to the secretory activity of the skin in getting rid of excessive fluid.

In winter, on the other hand, the whole of the excess of fluid has to be disposed of by the kidneys, resulting in an increased quantity of urine with a low specific gravity.

**Nervous Influences** In emotional states and hysteria, the urinary flow is sometimes increased. This is probably due to the effect of these conditions on the blood vessels of the kidney, causing them to dilate and allow more blood to pass through the kidney in a given time.

**EXCRETION OF URINE** The bladder walls are formed by layers of muscle fibres, which are stimulated to contract by increasing distension.

The fibres round the neck of the bladder, i.e. where the urethra

is attached to it, are arranged circularly, and form a sphincter muscle of not very great strength, which assists in preventing involuntary passing of the urine. The urethra itself has also a constricting muscle surrounding it just after it leaves the bladder, called the *Compressor Urethrae*, which also controls the passage of the urine.

The bladder muscles are controlled by involuntary nerves connected with the spinal cord, and the urethral constriction is controlled by voluntary nerves, also arising from the lower part of the spinal cord. In cases of injury or disease of this part of the cord, therefore, control of the urinary flow is sometimes lost.

### Mammary Glands.

These occur in only rudimentary form in the male. In the female they form two rounded masses, one on each side of the upper part of the front of the chest, and are formed of multiple lobulated glands surrounded by fat. The ducts of the glands open at the nipple.

*Function* The secretion of milk for feeding of infants. During pregnancy the glands become very much enlarged.

**SECRETION OF MAMMARY GLANDS** Human milk consists of water, fat, sugar of milk (lactose), salts, and albumen.

COMPARISON BETWEEN COMPOSITION OF COW'S MILK AND  
HUMAN MILK (*Starling*)

	<i>Human</i>	<i>Cow's</i>
Lactalbumen	2	4
Fats	2.75	4
Lactose	5	4.4
Salts	25	6
	<hr/>	<hr/>
Total solids	10	13
Water	90	87
	<hr/>	<hr/>
	100.00	100.00
	<hr/>	<hr/>

In order, therefore, to render cow's milk approximately equivalent to human milk, it is necessary to dilute it in order to reduce the percentage of albumen and fats, and then to add some sugar.

## CHAPTER XVII

### ANATOMY AND PHYSIOLOGY OF THE SKIN

THE skin is composed of two parts (i) the *Dermis*, which is a deep layer of fibrous tissue, and (ii) the *Epidermis*, which covers the dermis and consists of several layers of cells (*Epithelium*), the cells of the deeper layers of which are rounded, whereas those of the most external layers are flattened or "squamous"

In addition, the skin contains tubular glands which secrete sweat, and in some parts a greasy (sebaceous) material, these glands being called *Sebaceous Glands*. The hair and nails are outgrowths from the skin, and are to be regarded as parts of it.

#### The Dermis.

The dermis consist of a network of connective tissue fibres interlaced with blood vessels, nerves, and lymphatic channels. It is continuous on its deep surface with the connective tissue covering the muscles of the body.

#### The Epidermis.

Four separate varieties of cells are described as forming the epidermis, but they need not be detailed here. They are arranged in layers over the dermis, and whereas the deepest cells are rounded, the more superficial ones are flattened, and the outermost of all are merely dried scales. Such an arrangement of cells to form one membrane is called *Stratified Epithelium*.

#### Hairs.

These are derived from the epidermis. The hairs are derived from the deepest layer of the epidermis which grows downwards into the dermis and forms a flask-like group of cells, called a *Follicle*, and from the centre of this the hair grows, being sheathed by the neck of the flask, or follicle, as it passes outwards. The follicles are placed obliquely in the skin and are provided with minute muscular fibres which, by contraction, cause the hair to

stand more erect. Similar muscles enable animals to "bristle" their fur, and in man gives rise to the peculiar sensation of "goose skin."

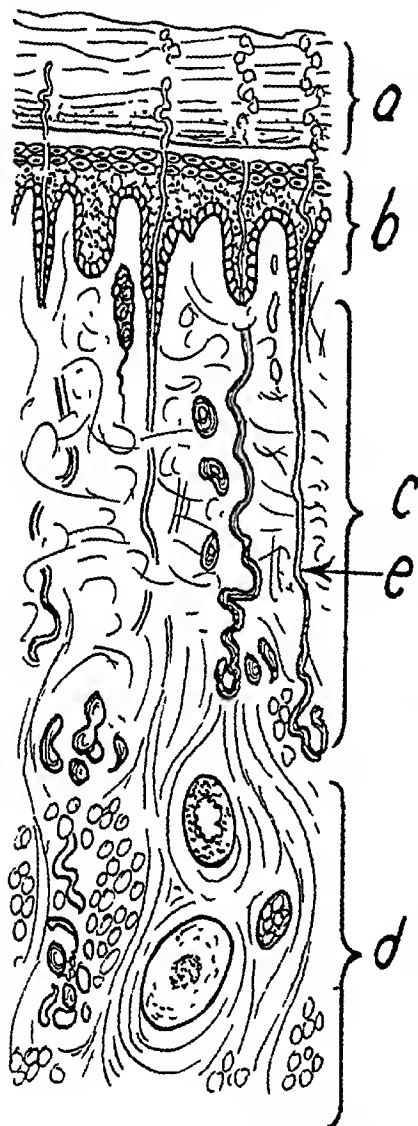


FIG 57—SECTION OF SKIN MAGNIFIED

- a = Superficial layer of the epidermis
- b = Epidermis
- c = Dermis containing (e) sweat glands
- d = Subcutaneous tissues containing nerves and blood vessels

### Nails.

These are in reality specialized parts of the epidermis. They are formed from the superficial layers of the skin, the cells of which deposit a horny substance, called *Keratin*, to which the hardness of the nails is due. The nail is tightly adherent to the deep layers of the skin, which, on removal of the nail, is found to be very vascular, and is called the *Nail Bed*.

When nails are removed, the nail bed re-forms them, unless the nail bed is also destroyed.

### Sebaceous Glands.

These are small flask-shaped glands situated in connection with the hair follicles, into which they open.

The sebaceous material (*Sebum*) is a greasy substance, and

consists of the broken-down cells of the gland, which become fatty, and the natural greasiness of the hair and skin is due to this

secretion As the cells degenerate, they are re-formed from those forming the walls of the gland

### Sweat Glands.

Each of these is formed of a single long coiled tube, the major portion of which lies in the subcutaneous tissue, and the duct, or straighter portion of the gland, passes through the dermis and epidermis in a corkscrew fashion, to open on the surface

Sweat is a clear fluid of salt taste It contains, in addition to water, about 2 per cent of solids, the chief of which is salt (sodium chloride) The sweat is being constantly secreted but normally in such small quantities that it evaporates as soon as it is formed, and the skin remains dry It is only during excessive activity of the glands that the sweat becomes perceptible

The function of the sweat secretion is to regulate the discharge of heat from the body The amount of heat contained in the warm sweat when excreted in large quantities, is considerable, and the loss of this heat, after exercise or in the warm weather, helps to maintain the body at a normal temperature

In addition to this, there is a small interchange of oxygen and carbonic acid gas through the skin, which, therefore, may be said to a very slight extent to assist in respiration



## CHAPTER XVIII

### THE LYMPHATIC SYSTEM

THE lymphatic system consists of lymphatic vessels and lymphatic glands. The cells of the body do not come in direct contact with the blood capillaries, but there is a small intervening space (*Lymph Space*) occupied by the clear fluid *Lymph*. The lymphatic vessels are the channels by which this lymph is conveyed through the lymphatic glands to the large main lymphatic vessels situated in the thorax and ending in the principal vessel, the thoracic duct, which opens into the veins of the neck at the junction of the internal jugular with the subclavian, on the right side.

There is a smaller lymphatic vessel opening into the corresponding point in the left side, but whereas this drains the lymph only from the left side of the chest, the left arm and left side of the neck, the whole of the lymph from the rest of the body drains through the thoracic duct into the veins on the right side.

#### **Lymph.**

Lymph may be regarded as a connecting link between the living cells and the blood. Oxygen and foodstuffs (carbohydrates and protein) are absorbed by the cells from the lymph, and the material so abstracted is replaced by the passage of the corresponding materials from the blood into the lymph. Similarly, carbonic acid gas formed by tissue activity passes through the lymph into the blood stream.

The second function of the lymph and lymphatic system is to maintain an equilibrium between the fluid in the blood and that in the tissues. Under certain circumstances, e.g. if for any reason the composition of the blood becomes altered, or during excessive activity of the cells, there may be a great effusion of fluid through the blood vessels into the tissues. This fluid is carried away by the lymphatics and restored to the blood, so maintaining a proper equilibrium of fluid in the tissues.

The third function of the lymphatic system is that of absorption.

The lymphatic vessels of the intestinal canal are very numerous, and into them is poured the digested food material (especially fats) after a meal. These lymphatics of the alimentary canal become so distended after a meal that they stand out as prominent white strands, as though filled with milk (the colour is due to the fat droplets), and hence are frequently called *Lacteals*. The whole of these lymphatics drain into a main abdominal lymphatic vessel, called the *Receptaculum Chyli*, which joins the thoracic duct above, and so the absorbed food products pass into the blood.

Lymph from the alimentary canal, when containing the absorbed foodstuffs, is called *Chyle*. The composition of lymph is similar to that of blood plasma (i.e. blood minus blood corpuscles). Its specific gravity is about 1.015, and it clots if drawn from the body, like blood, with a colourless clot of fibrin.

It has been said above that lymph is like blood without its corpuscles, this is perfectly true, but lymph contains also a variable number of white blood corpuscles (leucocytes), which are formed by the lymphatic glands and pass via the lymph to the blood.

### Lymphatic Glands.

All the lymphatic vessels pass at some time or another through one or more lymphatic glands. These are small bodies varying in size from a split pea to a small bean, and consist of a fibrous structure containing a large number of round cells similar to the leucocytes of the blood. There are wide lymph spaces in the glands, and so the lymph is brought into close relation with these cells, some of which are conveyed to the blood to form white blood corpuscles, and others remain and perform in the gland duties of a scavenging nature, similar to those of the white blood corpuscles.

It is for this reason that glands become enlarged if any infective material reaches them from any source. The enlargement of glands in the neck, due to absorption of poison from infected tonsils or teeth, is a common experience. It must be remembered that lymphatic tissue, wherever it is found in the body, performs this function, e.g. the tonsils are only specialized lymphatic glands, adenoid tissue, the vermiform appendix, and the patches of lymphatic tissue found along the alimentary canal (*Peyer's Patches*),

are all formed of lymphatic tissue and act as a protective mechanism against bacterial invasion

The lymphatic vessels are minute tubules passing along all the tissues of the body, and if they are laid open and examined under a microscope they are found to contain valves not unlike those of veins, which allow fluid to pass in one direction only, i.e. towards the Thoracic Duct. The movement of the lymph is very slow, and is effected by the pressure under which it is formed in the tissues, and also by the pressure of the contraction of the muscles of the body, the valves compelling the lymph to travel in the right direction.

The main functions of the lymphatic system, therefore, are threefold—

- 1 Protective against bacteria by the power of the leucocytes, which are formed in the lymphatic glands, and the lymph cells to destroy organisms
- 2 To maintain the equilibrium of the fluids in the tissues.
- 3 Absorbent of food material from the intestinal canal.

## CHAPTER XIX

### THE DUCTLESS GLANDS

THE ductless glands are so called because they are not supplied with any duct for the carrying away of their secretion, which is passed directly into the blood stream as it is formed

#### Internal Secretions.

The secretions of these glands are called for this reason, Internal Secretions. The ordinary type of glands provided with a duct, e.g. liver, submaxillary gland, mammary gland, etc., form a secretion which passes down the duct to its destination. Such a secretion is called an *External Secretion*.

During recent years a great deal of evidence has accumulated to prove that these glands also have internal secretions which have a profound physiological effect, but apart from the isolated cases of one or two of these glands, very little exact knowledge is available as to these internal secretions.

It might, perhaps, be mentioned here that the pancreas, in addition to its normal digestive secretion, produces an internal secretion which is absorbed directly into the blood, and which has a controlling influence on the absorption of sugar. The substance Insulin, which is now being used in the treatment of diabetes, is an internal secretion of the pancreas.

The genital glands have also an internal secretion which, by its action, gives rise to the secondary sexual changes which occur at puberty (e.g. the growth of the beard, breaking of the voice, are indirectly due to this secretion).

The glands which will be described in this chapter are the following—

- |           |               |          |
|-----------|---------------|----------|
| 1 Thyroid | 3 Suprarenals | 5 Thymus |
| 2 Spleen  | 4 Pituitary   |          |

#### Thyroid.

This is situated in front of the trachea and larynx, and consists of two lobes connected by a bridge or isthmus of gland tissue.

The isthmus lies across the upper part of the larynx, just below the cricoid cartilage. At each end of the isthmus is a lobe (right and left), oval in shape and extending upwards on each side of the larynx as far as the thyroid cartilage, the lower third of which is covered on each side by the gland. The lower pole of each lobe extends a little below the lower border of the isthmus. The

thyroid gland is extremely vascular, each lobe being supplied by three big arteries.

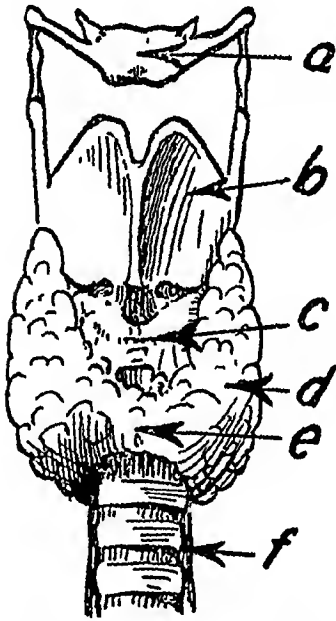


FIG 58—THYROID GLAND

- a = Hyoid bone
- b = Thyroid cartilage
- c = Cricoid cartilage
- d = Lobe of thyroid
- e = Isthmus of thyroid
- f = Trachea

If a section of the thyroid gland be examined under a microscope, it will be found to consist of a large number of spaces lined by cubical epithelium, and containing within them a clear jelly-like substance, called *Colloid*, which consists of a proteid substance combined with iodine.

#### FUNCTIONS OF THE THYROID GLAND

The internal secretion of the gland has a marked effect on the growth of the body. Cretins, in whom growth (mental and physical) is arrested in early life, have no active thyroid glands and rapidly improve if thyroid gland or its extract be administered.

Similarly, in adults, if the gland is destroyed by disease, a condition known as *Myxoedema* results. This is characterized by symptoms of general stupidity and clumsiness. The speech becomes slow and thick. The pulse is slowed and the subcutaneous tissues become enormously thickened, giving a coarse and clumsy appearance.

If normal individuals take thyroid extract, it is found that tissue waste occurs, fat is lost, and the pulse rate is increased.

#### Spleen.

This is a large gland situated in the left side of the abdomen,

immediately below the left side of the diaphragm beneath the ribs. The 9th, 10th and 11th ribs cover the gland. The gland is somewhat pyramidal in shape with a broad convex surface in contact with the diaphragm. The apex of the pyramid which forms the point of entry of the large splenic artery, is called the *Hilus*. Two sloping surfaces pass from the hilus to the base of the gland, one behind, which is in apposition to the kidney and one in front which lies against the stomach.

**FUNCTIONS OF THE SPLEEN** The spleen is an extremely vascular organ, and the cells of which it is composed are bathed in large blood spaces. If the gland substance is examined under a microscope, it is found to contain fragments of red blood cells and particles of brown colouring matter. In certain diseases the cells are also found to be filled with the organisms causing the disease, and the func-

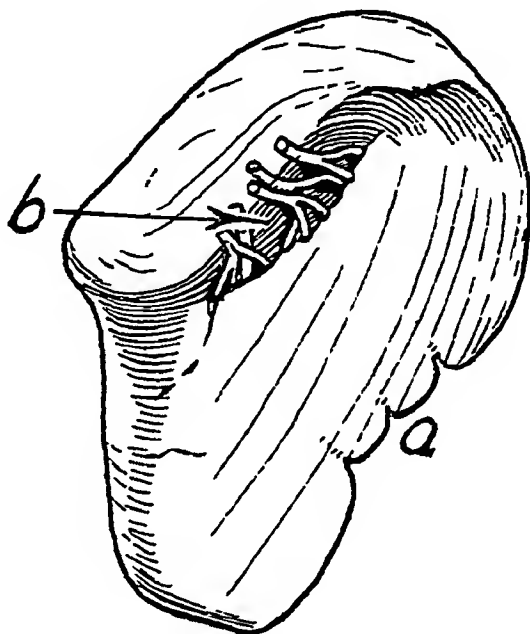


FIG 59—SPLEEN

a = Notched anterior border  
b = Hilus with vessels entering

tions of the spleen are usually for these reasons assumed to be those of purifying the blood, and of destroying effete red blood corpuscles, and possibly also of their manufacture.

### Suprarenal Glands.

These are situated one on each side, and surround the upper pole of each kidney like a small cap. They are triangular in shape, and on section are found to consist of an outer cortical layer and an inner medullary portion.

**PHYSIOLOGY OF THE SUPRARENAL GLANDS** The medulla of the suprarenal glands secretes an internal secretion, known as *Adrenalin*, or *Suprarenin*, which has a profound physiological

effect, very similar to that caused by stimulation of the sympathetic nervous system. It is interesting in this connection to note that the medullary portion of the glands is developed from the nerve tissue of the sympathetic system. The effects of the extract of the gland are—

1 Stimulation of involuntary muscle fibres, giving rise to increase in blood pressure owing to contraction of the muscular wall of the arteries, increase in the strength of the heart beat, and dilation of the pupil

2 In addition it increases the flow of saliva and, in fact, reproduces almost exactly the effects of sympathetic nerve stimulation

### Pituitary.

This is a small gland situated in the base of the skull (in a cavity in the body of the sphenoid, called the *Sella Turcica*). It consists of two lobes, an anterior derived from a backward growth of the tissues forming the cavity of the naso-pharynx, and a posterior lobe formed from the brain, to which it remains attached

**PHYSIOLOGY OF THE PITUITARY** The posterior lobe of the pituitary gland forms an internal secretion, known as *Pituitrin*, which has effects similar to those of *Adrenalin*. It causes increase in blood pressure and slowing of the heart. It also causes the muscles of the intestinal wall to contract

The anterior lobe forms a secretion which has a very marked effect on the growth of the skeleton

It sometimes occurs that this portion of the gland is overgrown, and may form a definite tumour. In these cases there is produced an overgrowth of the bones of the skeleton, especially of the face, hands, and feet (a condition known as *Acromegaly*). In individuals whose growth is still continuing, the presence of such a tumour may give rise to a general overgrowth of the skeleton (*Gigantism*), and gross abnormalities of growth as shown in individuals growing to 7 or 8 ft in height are nearly always associated with an overgrowth of the pituitary gland

### Thymus.

This is an irregular-shaped gland situated in the base of the neck,

below the thyroid. It is most prominently developed in infants, and tends to disappear after the age of puberty. Its function is not known. It is sometimes associated with enlargement of the lymphatic glands, a condition known as *Status Lymphaticus*. To this condition is sometimes attributed cases of sudden deaths during the administration of an anaesthetic.



## CHAPTER XX

### THE ORGANS OF THE SPECIAL SENSES

WE now pass on to a study of the organs of the special senses, viz. sight, hearing and smell

#### Eye.

The visual apparatus consists of the eye proper, by which are formed images of external objects, a nerve (the optic nerve) which communicates these images to the brain, and the occipital lobes of the brain, which receive the visual impulses and interpret them

**GLOBE OF THE EYE** This is, roughly, spherical in shape, with a slight bulge in front formed by the *Cornea*. The globe is divided into two divisions, a large posterior division filled with a jellylike clear substance, called *Vitreous Humor*, and a small anterior division filled with a clear watery fluid (*Aqueous Humor*). These two are separated from each other by the lens and its supporting structures.

The iris lies immediately in front of the lens and consists of a circular curtain of delicate muscle fibres, with a central aperture (pupil). The muscular fibres are arranged circularly and radially. The former, when they contract, narrow the pupil, and the latter by their contraction dilate it.

**THE COATS OF THE EYEBALL** The wall of the eyeball consists of several distinct layers. The wall of the posterior division of the eye is formed by the following three layers—

- 1 The innermost is the Retina
- 2 The middle is the Choroid
- 3 The most external is the Sclerotic

1 *The Retina* consists of a very delicate layer of cells forming the termination of the optic nerve fibres which enter the eye in a comparatively large bundle (the optic nerve), and then spread out in all directions so as to cover the inner aspect of the wall of the posterior division of the eye.

The cellular structure of the retina is extremely complicated

and consists of several layers of highly differentiated cells, containing a large amount of pigment. These layers need not be described in detail, but consist briefly of (i) layers of true nerve cells from which the optic nerve fibres originate; (ii) a layer of independent

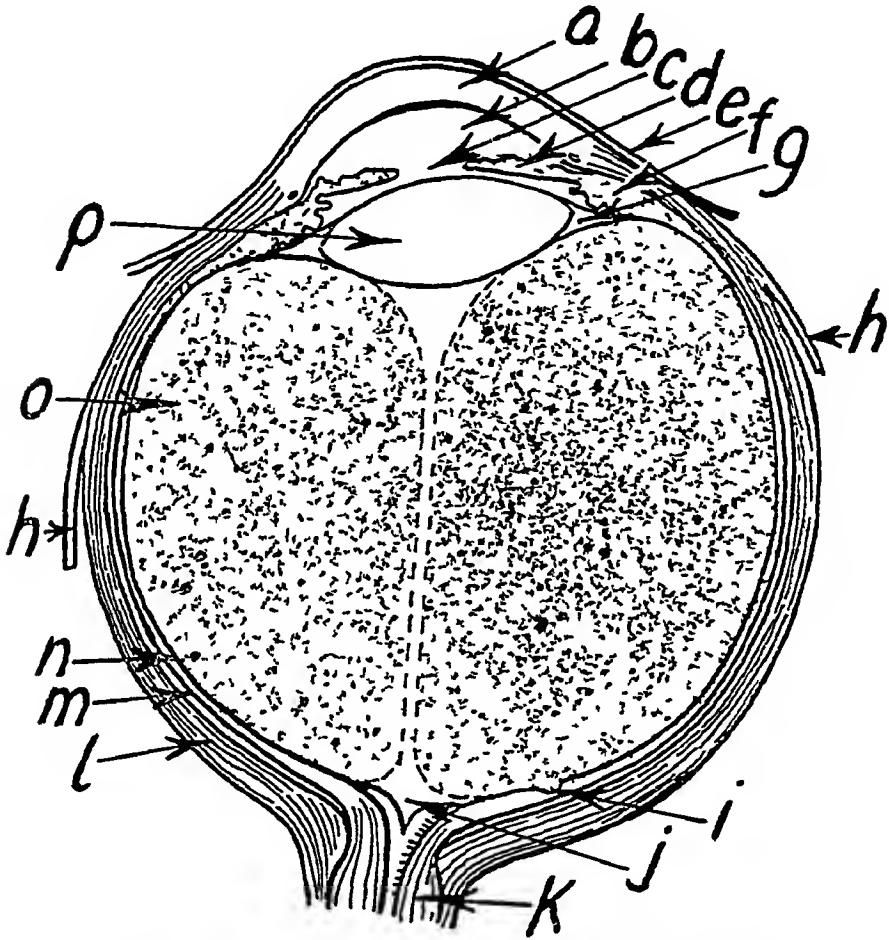


FIG 60—HORIZONTAL SECTION THROUGH THE EYEBALL

- |                                      |  |
|--------------------------------------|--|
| a = Cornea                           | i = Fovea centralis (yellow spot)        |
| b = Anterior chamber (aqueous humor) | j = Entrance of optic nerve (blind spot) |
| c = Opening of the pupil             | k = Optic nerve.                         |
| d = Iris                             | l = Sclerotic coat                       |
| e = Conjunctiva                      | m = Choroid coat.                        |
| f = Ciliary body                     | n = Retinal coat.                        |
| g = Suspensory ligament of lens      | o = Vitreous humor                       |
| h = Cut muscles of eye               | p = Lens                                 |

small nerve cells, probably acting as a connecting link between (i), and (iii) layers of highly specialized cells, some shaped like cones and others like rods which form the deepest layer of the retina (i.e. the most external). It is in this layer of rods and cones that the visual impressions are started.

2 *The Choroid* is a pigmented membrane lying outside the retina, continuous in front with the iris, and containing a large number of blood vessels.

3 *The Sclerotic* is the white fibrous layer which encloses the whole eyeball except in front

*The Lens* is biconvex in shape, i.e. both anterior and posterior surfaces are convex, the posterior surface being more convex than the anterior. It is formed of a transparent crystalline material, and is supported in a transparent capsule which is attached round its circumference to a suspensory ligament.

The lens and suspensory ligament together form a dividing partition between the anterior and posterior divisions of the eye. The iris lies immediately in front of the lens.

*Suspensory Ligament* This is a fine membranous ligament attached round the circumference of the lens capsule, and passing to the posterior part of the ciliary body. On contraction of the ciliary muscle the suspensory ligament is relaxed and the lens becomes more convex.

*Ciliary Body* This is a continuation of the choroid coat of the eye, and is the thickened anterior circular edge of the choroid. It consists of blood vessels and circular muscles which, by their contraction, tend to constrict the ring of the ciliary body and so cause relaxation of the suspensory ligament of the lens.

The iris is attached to the front of the ciliary body, and is continuous with it.

The anterior part of the eye is bounded in front by the perfectly transparent membrane, called the *Cornea*, which bulges slightly forwards and forms the window of the eye, through which all the light passes.

*The Conjunctiva* is a thin transparent membrane which lines the front part of the orbit, being reflected from the under surface of the eyelids on to the eyeball, and terminating at the cornea.

The function of the conjunctiva is to provide a lubricated surface to enable the eyeball to move readily in the orbit.

It is lubricated by the secretion of the *Lacrymal Gland*, which is situated in the orbit between the eyeball and the outer and upper part of the orbit. The secretion of this gland (*Tears*) passes between the layers of the conjunctiva, being conveyed there by

several small lacrymal ducts, and is drained by the nasal ducts, which are situated in the angle of the eye near the nose, and pass down to open inside the nasal cavities. In this way there is

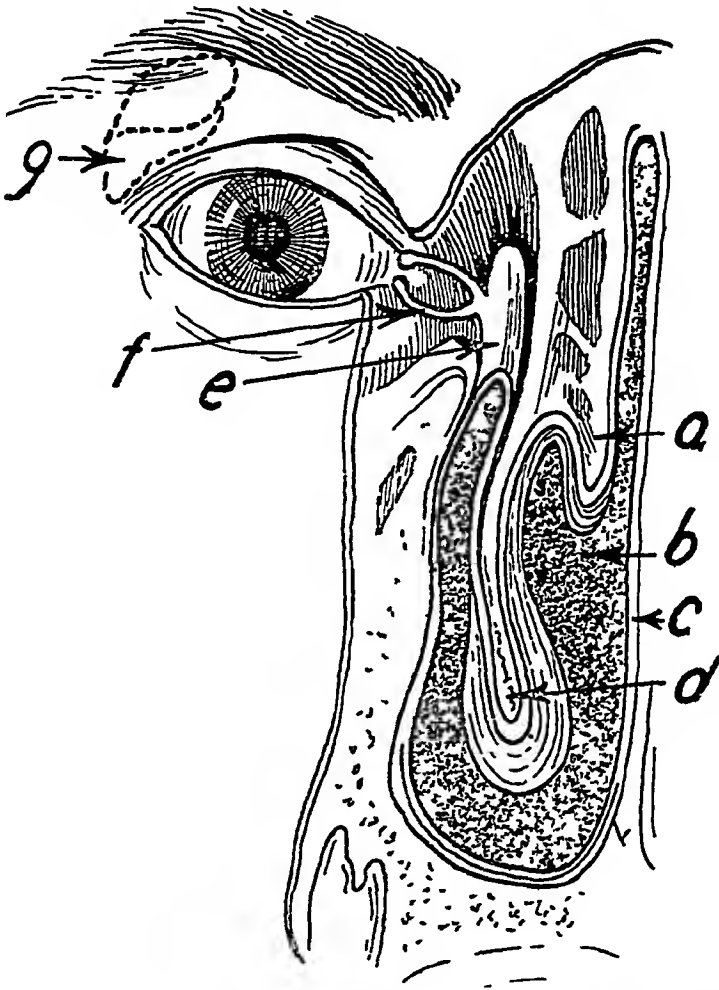


FIG 61 —DIAGRAM ILLUSTRATING THE LACRYMAL APPARATUS

*a* and *d* = Turbinal bones  
*b* = Nasal cavity  
*c* = Septum of nose

*e* = Lacrymal sac.  
*f* = Canaliculi or nasal ducts  
*g* = Position of lacrymal gland

a continuous flow of clear lubricating fluid over the surface of the eye.

The upper end of the nasal duct is somewhat expanded into a sac-like extremity, called the *Lacrymal Sac*, and it is into the side of this that the ducts (two in number, called *Canaliculi*) which drain the tears from the eye, open

**PHYSIOLOGY OF THE EYE** The function of the eye is to convey images of external objects to the brain

These images are formed on the retina and by stimulation of the nerve endings of the optic nerve, such images are conveyed to the occipital lobe of the brain, where they are consciously perceived

The essential mechanism of the eye, therefore, is to produce on the retina clear images of external objects. It effects this in very much the same way as a camera produces an image on the photographic plate

In order to understand this, some elementary knowledge of physical optics is necessary

If a ray of light passes from one medium, e.g. air, through another of different density, e.g. water or glass, the ray is bent at an angle on passing from the one to the other

Thus, if a ray of light passes through a glass plate it is bent at an angle on entering the glass, and is again bent on emerging from the glass. If the surfaces of the glass are parallel, the direction of the ray on emerging from the glass is parallel to the direction it had on entering it

On the other hand, if the surfaces are curved and the curves are of different degrees or of opposite direction, the rays of light will converge towards, or diverge from each other, after passing through the glass

Thus, in the case of an ordinary glass lens, the two surfaces are curved in opposite directions (convex lens), and it is found that if parallel rays of light enter such a lens at one surface, they are bent towards each other as they emerge from the opposite surface, and if the lens is accurately made, meet in a point which varies in position according to the degree of curvature of the surfaces of the lens

The greater the curvature, the nearer is this point to the lens. This point is called the focal point of the lens, and the rays of light are said to be focused at that spot

If the object focused is so close to the lens that the rays of light do not enter quite parallel, the focal point will be farther away from the lens

In a camera, focusing is effected by moving the screen backwards or forwards until it reaches this focal point, and the object

viewed forms a perfectly clear image on the screen. It is also to be observed that such images are inverted.

In the eye the bending or refraction of the light occurs first in the watery fluid of the anterior chamber, then in the lens, and then in the vitreous humor. The inverted image is formed on the retina if the lens is of the correct curve.

But inasmuch as objects viewed vary in distance from the eye, it is clear that the curvature of the lens will not be correct for all objects, and whereas in the camera the screen is moved towards or away from the lens, in the eye the same effect is produced by altering the curvature of the lens.

This is effected by the contraction or relaxation of the ciliary body, to which the lens is slung, and as the lens is pliable and elastic, if the containing capsule is tightened by contraction of the ciliary muscle the lens becomes flattened and throws the image farther back, whereas if it is relaxed the lens is thickened and the image is thrown farther forwards.

This is called accommodation of the eye, and is accompanied by alteration in the size of the pupil, which becomes enlarged for viewing near objects, and contracted for distant ones.

It sometimes happens that the distance from the lens to the retina is such that no amount of available accommodation is sufficient to set a clear image on the retina. If the distance is too great the image is thrown in front of the retina for distant objects (where the light rays are approximately parallel), whereas with near objects, the focal point being farther away from the lens, as explained above, a clear image may be obtained. Such an eye is shortsighted (*myopic*) and needs a concave lens placed in front of the eye to get a clear image on the retina.

The opposite condition (long sighted or *hypermetropic*) is present if the lens, when fully accommodated, throws the image too far back. The focal point has then to be brought on to the retina by placing a convex lens in front of the eye.

*Presbyopia* is a similar condition, but is due not to shortening of the eyeball, but to a loss of elasticity in the lens, which occurs with old age and prevents the individual from focusing for near objects.

As in true hypermetropia, glasses have to be used for reading in these cases.

**FUNCTIONS OF THE IRIS** The use of the Iris is essentially to control the amount of light entering the eye. Thus in the dark, when the maximum amount of light is needed to produce a retinal impression, the pupil is dilated, whereas in a bright light it may be contracted almost to a pin point. The alteration in size of the pupil to differing degrees of light is known as the light reflex and varies in degree, or may be obliterated altogether in some diseases.

*Blind Spot* All points on the retina are not equally sensitive to light, and there is one spot (the blind spot) which is totally insensitive. This is the spot where the optic nerve enters the eyeball, and is situated a short distance to the nasal side of the central point of the retina.

The midpoint of the retina, or a point very close to it, is most sensitive to light. It is of a yellowish colour, and the surface of the retina is slightly depressed at this spot, which is called the *Macula Lutea*, or "yellow spot" (See Fig 60).

**MOVEMENTS OF THE EYE** The eyeball is free to rotate in any direction in the orbit, this freedom being provided by the lax tissue surrounding the eyeball, the smooth conjunctiva allowing easy movement, and by the comparative slackness of the optic nerve and vessels at the back, which form the only really firm attachment of the eye.

The eyeball is moved by muscles which arise from the bony wall of the orbit and are attached at different points to the globe of the eye, mostly just in front of the equator (line of maximum circumference). These muscles are six in number and are named—

- |                   |                    |
|-------------------|--------------------|
| 1 Internal Rectus | 4 Inferior Rectus  |
| 2 External Rectus | 5 Superior Oblique |
| 3 Superior Rectus | 6 Inferior Oblique |

The first four arise from the back of the bony orbit and are inserted at points round the circumference of the eye as follows: the internal rectus on the nasal side, the external rectus on the outer side, the superior rectus above and the inferior rectus below.

Owing to the fact that these muscles do not arise from the exact mid-point of the posterior wall of the orbit, but rather to the nasal side, their contraction does not produce movements of the eye in one direction only, e.g. upwards or downwards, but when the

superior rectus contracts, it draws the eye upwards and inwards, and the inferior rectus draws it downwards and inwards

The oblique muscles are more complicated in position. The superior oblique arises from the back of the orbit and passes forwards to a little "pulley" in the upper and inner angle of the orbit through which the tendon passes, and then stretches backwards and outwards to be inserted into the outer half of the globe. The contraction of the muscle therefore moves the globe downwards and outwards.

The inferior oblique lies beneath the eye and arises from the floor of the orbit towards the inner side, and passes backwards and outwards to be inserted into the outer half of the inferior surface of the eyeball. By its contraction, therefore, it draws the eye upwards and outwards.

**BINOCULAR VISION** In order that man, although provided with two eyes, shall see only one image of any given object, exact co-ordination between the movements of the eyes is essential, and for this purpose the nerve supply and action of the muscles are so arranged as to cause both eyes to move simultaneously in corresponding directions.

If for any reason the powers of the muscles of each eye are not the same, both eyes do not move exactly together and a double or blurred image is produced.

In extreme cases, if one of the muscles of either or both the eyes is paralysed, a squint results.

The advantage to man of having binocular vision is that it enables him to judge distances, the eyes being slightly distant from each other, a corresponding slight difference in the image as seen by each eye is produced, and this gives the appearance of solidity.

This is shown by the simple experiment of the stereoscope, where a photograph which normally gives a "flat" view, conveys a "solid" impression to the brain if viewed simultaneously but independently by each eye.

This difficulty in judging distances is the only handicap from which a man suffers who has lost the sight of one eye.

**COLOUR VISION** Ordinary white light, if passed through a glass prism, is found to be split up into various colours, and it is



thus demonstrated that white light is composed of a mixture of colours which, when viewed simultaneously, gives the sensation of white

The difference of colours is due to the different wave lengths of ether to which each gives rise

There are various theories as to how the retina responds to these wave lengths, and gives rise to the colour sensation in the brain. These are too intricate to discuss here, but it may be mentioned that physiologically the sensation of a white light is produced by the retina if it is stimulated by various pairs of colours

The whole of the prismatic colours need not be used. Thus, red and green when viewed simultaneously will produce the effect of white light, also blue and yellow will have the same effect. Such pairs of colours are called *complementary colours*

The retina is frequently incapable of responding to all the various wave lengths of the colours, the commonest failing being an inability to distinguish red. As the complementary colour to red is green, it is found that such people, who are said to be colour blind, will call red green. A mild form of such a condition is very commonly met with in people who have a difficulty in distinguishing at a distance red berries on a green tree. Such people have weak colour vision, though they are not actually colour blind

## **Ear.**

The ear is made up of three separate parts, called—

- 1 The External ear
- 2 The Middle ear.
- 3 The Internal ear

In brief, the functions of these three parts are—

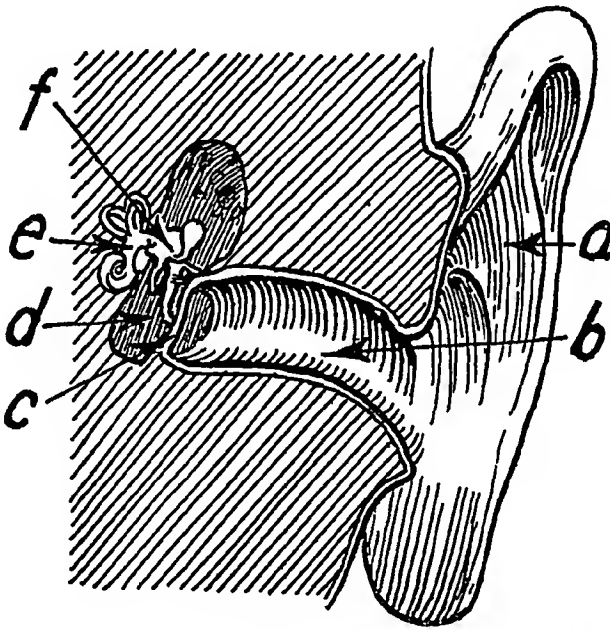
- 1 The external ear collects the sound waves
- 2 The middle ear transmits them to the internal ear
- 3 The auditory nerve impulse is started in the internal ear.

## **ANATOMY.**

1 *External Ear.* This is the visible part of the ear (called the *Pinna*). It is formed of a peculiarly-shaped cartilage covered by skin. The skin is continued as a hollow cylinder along the bony

canal leading from the external ear to the middle ear. This canal is called the *External Auditory Meatus*. It passes forwards and inwards, and ends at a partition (the external drum of the ear, or tympanic membrane), which stretches right across the canal and shuts it off completely from the middle ear. It is composed of a layer of fibrous tissue covered outside by a thin layer of skin.

2 *The Middle Ear* This lies within the petrous portion of the temporal bone (*qv*), and is shaped like a long narrow box with bony walls.



62 — DIAGRAM OF INTERNAL, MIDDLE AND EXTERNAL EAR

- |   |  |
|---|--|
| a = External ear (pinna)                | e = Internal ear (Cochlea and semicircular canals) |
| b = External auditory canal             | f = Ossicles of the middle ear                     |
| c = Tympanic membrane (drum of the ear) |  |
| d = Cavity of middle ear                |  |

It has several apertures in its walls, all of which are important in one way or another.

In the outer wall is the aperture of the external auditory meatus, across which the external tympanic membrane is stretched.

In the posterior wall is an aperture leading back to the air space in the mastoid process (*qv*).

In the anterior wall there is an opening which communicates by means of the Eustachian Tube (*qv*) with the pharynx.

In the inner wall are two openings, an oval one (the *Fenestra*

*Ovalis*) and a circular one (the *Fenestra Rotunda*) Each of these is covered by membrane and communicates directly with the internal ear

The roof of the middle ear is formed by an extremely thin plate of bone, immediately on the other side of which lies part of the brain

*Ossicles* Stretching across the middle ear from the outer to the inner wall is a chain of three small and peculiarly shaped bones These are called the *Malleus*, *Incus*, and *Stapes* The malleus is attached to the external tympanic membrane, and the stapes to the fenestra ovalis, and the incus connects the malleus with the stapes

3 *The Internal Ear* This is an extremely complicated mechanism which lies in the petrous portion of the temporal bone on the inner side of the middle ear It is divided into three parts, the *Cochlea*, the *Vestibule*, and the *Semicircular Canals*

These are all hollow cavities bounded by a layer of fibrous tissue lying within correspondingly shaped cavities in the bone They all communicate, and are filled with lymph

The cochlea is shaped like a snail's shell, and communicates with the vestibule, which lies between it and the semicircular canals. The cochlea communicates with the middle ear by the fenestra rotunda

The vestibule is the central chamber of the internal ear, and communicates with the middle ear by the fenestra ovalis, which is filled in by the base of the innermost ossicle (the stapes) It communicates behind with the semicircular canals, which are three in number

The semicircular canals are small membranous canals semicircular in shape, and lying in three different planes, one horizontal, and two vertical, all at right angles to each other

The whole of the internal ear (the semicircular canals, vestibule, and cochlea), is sometimes spoken of as the *Labyrinth* on account of its intricate form

The endings of the auditory nerve are found in the cochlea, which is the essential organ of hearing

PHYSIOLOGY OF THE EAR Sensations of sound are conveyed to the brain by the auditory nerve The nerve endings lie in the

Cochlea (see above) and the sound waves are transmitted to them as follows—

The sound waves enter the external ear and cause the drum of the ear (external tympanic membrane) to vibrate. This vibration is transmitted by the three auditory ossicles to the vestibule of the internal ear through the fenestra ovalis and are thence transmitted to the cochlea, and so to the auditory nerve endings.

In order that the drum of the ear may vibrate well, it is necessary that the air pressure on each side of it should be equal. This is effected by the opening of the Eustachian tube in the middle ear, which communicates with the outside air in the pharynx.

## Nose.

The bony structure of the nose has already been described (See *Bones of the Face*, Chapter I.)

It would be useful, however, briefly to recapitulate the main points in the anatomy of the nose.

The two nasal cavities are separated from each other by a narrow vertical partition, composed of bone behind and cartilage in front (the bony and cartilaginous *Septum*). Behind they communicate with the naso-pharynx or space lying above the soft palate.

Their outer walls are separated by a comparatively wide interval from the septum below, but this interval is very much narrowed above.

There are three flake-like bones curving downwards and inwards from the outer walls, and so encroaching on the nasal cavities. These are the turbinate bones.

There are three important apertures in the bony wall of the nose on each side, one above communicating with the frontal sinuses of the skull, one a little lower, which is the lower end of the nasal duct, and which drains the secretion of the lacrymal glands from the eyes (*q v*), and the third is the opening of the large space (the *Antrum of Highmore*), lying in the superior maxillary bones.

All these cavities are lined by mucous membranes, which are thus indirectly continuous with each other. The olfactory nerve (nerve of smell) ends in a large number of fibres in the upper part of the nasal cavities.

**PHYSIOLOGY OF THE NOSE** The nose is the essential organ of

smell, and this sensation is conveyed to the brain by the olfactory nerve. In addition the nose is, or should be, the means by which air passes from outside into the lungs. The many folds into which the mucous membrane is thrown by means of the turbinate bones ensures that the air shall come in contact with a large surface of warm mucous membrane, so that cold air does not reach the throat and lungs.

The nose is also provided with hairs within its orifice which, by pointing towards the outside, filter the air to a large extent of its dust particles.

## SECTION II

### COMMON DISEASES AND ACCIDENTS

(Including Industrial Diseases)

It is not intended in this section to do anything more than indicate briefly the main symptoms, sequelae, and duration of the more common diseases and accidents

For convenience they will be divided, as far as possible, into groups according to the system or parts of the body chiefly affected. This is in some ways a bad classification, as it must be remembered that no organ of the body can be diseased without affecting to a greater or less extent, other parts, or even the whole body. The author's excuse for such a classification is its convenience.

The first group, however, will be infective diseases, i.e. those due to specific germs.

The object of this section is not to enable the reader to diagnose a disease, but merely to give the chief symptoms, common sequelae and approximate duration of incapacity resulting from the various diseases.

It is clear that in many cases, e.g. heart disease or general constitutional diseases, a time limit cannot be given.

## CHAPTER XXI

### INFECTIVE DISEASES (DISEASES DUE TO SPECIFIC INFECTIVE ORGANISMS)

#### **Actinomycosis.**

**CAUSE** Due to organism known as *Streptothrix Actinomyces*, or "Ray-fungus" Mode of infection Organism is probably taken in food

**SYMPTOMS.** The disease occurs in two forms—

1 *Digestive* Swelling of jaw or tongue due to an inflamed mass of tissue from multiple spots on which a bright yellow pus exudes

2 *Pulmonary.* The lungs are infected and common symptoms are cough, fever, wasting, and a purulent expectoration

The treatment is incision of the inflamed area and scraping out of the diseased tissue

**SEQUELAE** Nil

**DURATION** Indefinite Result frequently fatal

#### **Anthrax.**

**CAUSE** The entry of an organism known as the *Bacillus Anthracis* into the skin, usually transferred from the hides or hair of animals who have been infected with the disease, which is common among foreign animals The bacillus is very resistant, and its spores can live inert a long time and subsequently develop under favourable circumstances

**SYMPTOMS** The disease occurs in two forms—

1 *External Anthrax* Malignant Pustule Inoculation usually occurs on the head, neck, and arms, i.e. where the skin is exposed Within a few hours of infection a small "pimple" appears and the surrounding tissues become angry, red and hard The centre then becomes dark brown or black in colour, and all the neighbouring parts become swollen Infection of the neighbouring lymph glands occurs

The treatment is excision, and carbolic acid or mercuric chloride injected in the surrounding tissues to prevent the growth of organisms there An anti-anthrax serum is sometimes successful

SEQUELAE Nil, except deformity due to scarring

DURATION Three to ten days, when death supervenes unless the pustule is excised and strong antiseptics, e.g. mercury or carbolic acid, are applied

## 2 *Internal Anthrax*

(a) *Intestinal* The symptoms are initial chill, vomiting, diarrhoea, fever, and general pains. Enlargement of spleen

SEQUELAE Nil

DURATION Two to fourteen days

(b) *General Infection* Wool Sorters' disease. Caused by the inhalation of anthrax bacilli from wool and hair during sorting and cleaning. Skins from Russia are most dangerous. The symptoms are initial chill, prostration, general pains, cough, and rapid breathing. High temperature and rapid pulse

SEQUELAE Nil

DURATION Three to fourteen days. Usually fatal

## Asiatic Cholera.

CAUSE Infection by the "Comma" bacillus. Usually conveyed to man in water, or food that has come in contact with infected water

SYMPTOMS Incubation period two to five days. The initial symptoms are diarrhoea, abdominal colic, vomiting. These gradually become worse and the motions are frequent and entirely liquid, like rice-water. Great thirst follows with cramp in legs and feet. Rapid wasting. Temperature usually subnormal, although if taken per rectum an increase is found

SEQUELAE Nephritis, colitis, pneumonia

DURATION From two days onwards, according to severity

## Black Water Fever.

A disease met with in the tropics and allied to malaria. It is doubtful if it is a separate disease and is probably a variety of malaria, associated with the passage of altered blood in the urine

## Cerebro-spinal Fever (Spotted Fever)

CAUSE Infection of the coverings of the brain (*Meninges*) by the *Diplococcus Intracellularis*

SYMPTOMS Sudden onset with headache, vomiting and severe



chill Rise in temperature with a full pulse A most important symptom is pain and rigidity of the muscles at the back of the neck and severe headache Irritability and photophobia Later the muscles of the back contract, and the head is drawn back and the back arched Delirium A rash consisting of red or purple spots is common.

SEQUELAE Pneumonia, optic neuritis, otitis and deafness, persistent headache

DURATION Two days (severe fatal cases)—six months

### Chicken Pox.

An acute contagious disease chiefly affecting children.

INCUBATION PERIOD Ten to fifteen days

CAUSE Unknown

SYMPTOMS Increase of temperature Rash consisting of small vesicles or pimples, containing clear fluid, appears after twenty-four hours and may be preceded by a diffuse redness of the skin After two to three days the vesicles shrivel and leave a small brown crust, which then drops off and as a rule leaves no scar Rash is most marked on the trunk Mode of spread is by personal contact with an infected patient

COMPLICATIONS OR SEQUELAE Nephritis

DURATION Three weeks Infective until all spots have disappeared

### Diphtheria.

CAUSE Infection of mucous membranes (usually of the throat) by a bacterium called after its discoverer, the Klebs-Löffler bacillus

INCUBATION Two to seven days

SYMPTOMS Sore and inflamed throat Greyish membrane covering the infected mucous membrane Dyspnoea due to partial obstruction of the air passages by the membrane, which may cause complete obstruction and suffocation Increase of temperature

The essential part of the treatment is the use of Diphtheritic antitoxin It is frequently necessary to open the larynx in the neck below the obstruction caused by the membrane, in order to enable the patient to breathe (This operation is known

as *Tracheotomy*) The opening is allowed to close as soon as the membrane is separated and normal breathing is possible

COMPLICATIONS OR SEQUELAE Cardiac weakness, neuritis, broncho-pneumonia, nephritis, paralysis, frequently of the palate

DURATION From six weeks upwards The organism may remain active in the throat and infective for other people long after all symptoms have disappeared

### Dysentery.

This occurs in two forms—

(i) Caused by the *Amoeba Dysenterica*

(ii) Caused by the *Bacillus Dysentericus*

(i) *Amoebic Dysentery* Occurs chiefly in tropics

SYMPTOMS Acute abdominal pains and "tenesmus" (an ineffectual desire and straining to evacuate the bowel) Passage of blood and mucus per anum Increase in temperature Ema-ciation Chronic alternating constipation and diarrhoea—recur-ring slight increase in temperature—pain in abdomen, and tenesmus with recurring passing of blood and mucus

COMPLICATIONS Perforation of the bowel, followed by general peritonitis, abscess of the liver

DURATION Acute one to three months Chronic: For months or years

(ii) *Bacillary Dysentery* Occurs in insanitary areas, uncommon in temperate climates

SYMPTOMS Sudden onset with abdominal pain, frequent evacuation of the bowels, and slight rise in temperature Blood and mucus in stools This form may be acute or chronic The former may result in death within a few days

SEQUELAE Chronic diarrhoea, colitis

DURATION Acute two to three weeks Chronic: indefinite

### Encephalitis Lethargica (Sleepy Sickness)

CAUSE Unknown It is probably due to an organism which has not been identified It is a disease which has only recently been recognized

SYMPTOMS The onset is usually gradual, the first symptoms

being pain in the head and general pains in the body, with a rise of temperature. Gastric symptoms sometimes occur, vomiting and hiccough being not uncommon. The characteristic symptom, which has given rise to the name of the disease, is a lethargy from which the patient can be roused, but into which he rapidly sinks back. Signs of meningitis (*q v*)

**COMPLICATIONS** Ocular paralysis, diplopia, loss of power of concentration and neurasthenia

**DURATION** Indefinite. It may prove fatal, or the patient may recover within a few days. In some cases mental and nervous symptoms persist for many months

### Erysipelas.

**CAUSE** A contagious disease caused by an organism known as the *Streptococcus Erysipelatus*, and characterized by marked inflammation of the skin

**SYMPTOMS** Onset usually sudden with marked rise of temperature. The inflammation of the skin appears within a few hours, frequently in the neighbourhood of a small wound or abrasion, which has become infected with the organism. The skin and deeper parts may be very swollen, and, if on the face, the eyes may be completely closed

General symptoms of blood poisoning follow. (See *Septicaemia*)

**COMPLICATIONS** Heart disease (endocarditis), septicaemia

**DURATION** One to three weeks

### Glanders.

An infectious disease common in horses and occasionally communicated to man

**CAUSE** It is due to a specific bacterium, the *Bacillus Mallei*.

**SYMPTOMS** Acute. The characteristic feature is the development of nodules usually of the nose. Increase of temperature. The nodules in a few days break down into ulcers. General infection occurs and a fatal result is invariable in the acute form

**SEQUELAE** Nil

**DURATION** Seven to ten days

**Chronic** Chronic ulceration and discharge from the nose or larynx.

SEQUELAE Septicaemia ; disability may result from scarring  
DURATION Indefinite

Another variety of Glanders due to infection of the skin by the same organism, is known as "Farcy" It may be acute or chronic, and is characterized by nodules and ulcers developing in the skin, followed in acute cases by septicaemia and death In chronic cases the condition may last a long time Treatment of this form usually consists of excision of the ulcers and nodules

### Gonorrhoea.

CAUSE Local infection of the urethra in the male, or vagina in the female, by the *Gonococcus* Transmitted by sexual intercourse most commonly, but direct contact with infective material, however effected, may cause the disease It commonly affects the eyes and genitals of children newly born from an infected mother

SYMPTOMS Local Redness of the urethral orifice Scalding on passing urine Enlargement of inguinal lymphatic glands Inflammation of the prepuce (foreskin), followed after a few days by thick urethral discharge

COMPLICATIONS Spread of infection to bladder, causing cystitis, to testicles, causing orchitis and epididymitis, to Fallopian tubes in the female, causing salpingitis, and to the uterus, causing metritis

The heart may be affected, giving rise to endocarditis

Arthritis of a very acute type may affect any joint

Iritis may occur apart from direct infection of the eyes

Stricture of the urethra is very common, caused by contraction of the urethral canal, owing to scarring This may be followed by retention of urine and nephritis

*In Children* The disease affecting the eyes, unless, as is usually done, the eyes are properly treated at birth, is followed by an acute inflammation of the eyes, which may result in permanent blindness

DURATION Indefinite

### Hydrophobia (Rabies)

CAUSE Acute disease caused by infection from the bites of infected animals (usually the dog)

INCUBATION Six to eight days

**SYMPTOMS.** 1. *Premonitory Stage.* Irritation at the site of the wound ; mental depression and fear.

2. *Stage of Excitement* Spasmodic attacks of painful contraction of the muscles at the slightest stimulus, e.g. a noise or even a light may precipitate an attack. The spasm of the throat muscles on attempting to drink gives rise to the name of the disease (Fear of water)

3 *Paralytic Stage.* Unconsciousness gradually develops , the patient becomes paralysed and quiet, and the heart gradually fails

**COMPLICATIONS** Nil. It is invariably fatal, unless the patient is treated by inoculation before the symptoms appear

**DURATION.** Seven to ten days

## Influenza.

An acute infection, usually of the respiratory organs, sometimes of the abdominal organs, associated with rise of temperature and general muscular pains

**INCUBATION** Two to four days

**CAUSE.** Unknown.

**SYMPTOMS** Rise in temperature , catarrhal symptoms, running from the nose, cough, and frequently sore throat General muscular pains and headache In abdominal type there may be acute abdominal pain and diarrhoea

**COMPLICATIONS AND SEQUELAE** Bronchitis , pneumonia , endocarditis ; neuritis

**DURATION.** Seven to twenty-one days

## Leprosy.

**CAUSE** An infectious disease caused by the *Bacillus Leprae*, producing nodules in the skin and nerve changes (loss of sensation).

**SYMPTOMS** Nodules develop beneath the skin, which gradually involve this and ulcerate, giving rise to extensive destruction of tissue and scarring with deformity In some cases the toes may be completely destroyed and the eyes may be affected

In the nerve variety, the nerves are principally affected, and numbness develops, followed by ulceration of the skin supplied by the affected nerves

**SEQUELAE.** The skin may become completely blanched in patches

**DURATION** Indefinite, and may last for years

### **Malaria.**

**CAUSE** An acute infection caused by the malarial organism, transmitted to man by the bite of a mosquito, in tropical and subtropical countries

**SYMPTOMS** The disease is met with in a variety of forms, but the chief characteristic symptoms of the ordinary variety are headache, shivering, fever and sweating, following regularly in sequence, so that an attack occurs every forty-eight hours or every seventy-two hours. The time varies according to the variety of organism present, one variety taking forty-eight hours to develop, and the other seventy-two hours. The former variety is called the Tertian and the latter the Quartan. Enlargement of the spleen is common.

**COMPLICATIONS AND SEQUELAE** Persistent enlargement of spleen, nephritis, endocarditis

**DURATION** From ten days onwards, and is extremely likely to recur even after the patient has been removed from the malarial zone

### **Measles.**

**CAUSE** Unknown

**INCUBATION** Seven to eighteen days

**SYMPTOMS** Catarrh of the nose and throat, running from the eyes, high temperature, rash appearing as blotches of red over the face and trunk

**COMPLICATIONS AND SEQUELAE** Bronchitis and broncho-pneumonia, otitis media, mastoiditis, nephritis, arthritis

**DURATION** Ten to twenty-one days

### **Measles (German)**

**CAUSE** Unknown

**INCUBATION** Two weeks

**SYMPTOMS** Catarrh of nose and throat, headache, pains of back and legs, enlargement of glands in neck, sore throat, rash

over most of the body in small red patches, slight rise in temperature.

SEQUELAE. Very rare, usually none

DURATION One to three weeks

### Mumps.

An infectious disease associated with enlargement of the parotid salivary glands

CAUSE Unknown

INCUBATION Two to three weeks

SYMPTOMS Rise of temperature, pain below and in front of the ears, swelling of the parotid gland in this region, accompanied by pain and difficulty in opening the mouth and masticating

SEQUELAE Orchitis is not uncommon in males; other complications are rare, e.g. arthritis, albuminuria, otitis.

DURATION Three to four weeks

### Plague.

A highly infectious disease common in the Far East, but very rare in Europe or America

CAUSE A specific organism called the *Bacillus Pests* Rats are the chief agent in carrying the infection

SYMPTOMS Increase in temperature, general pains in limbs and headache, swelling of the lymphatic glands is common, especially of the groins, hence the term Bubonic Plague

SEQUELAE Septicaemia may develop in a few days from the onset and usually proves fatal, or pneumonia may be the characteristic feature in other cases, and is equally fatal

DURATION Frequently fatal within a few days

### Pneumonia (Lobar Pneumonia)

See also *Broncho-Pneumonia* (Chap XXII)

CAUSE An acute infection of the lungs due to the *Pneumococcus*

SYMPTOMS Onset sudden with high temperature, rapid pulse and respiration rate, breathing is laboured and the nostrils, especially in children, are frequently dilated, dry cough, blood-tinged expectoration After seven to ten days the temperature suddenly comes down and acute symptoms subside.

COMPLICATIONS Pleurisy, pericarditis; endocarditis, meningitis

DURATION. Two to eight weeks

Apart from the above primary pneumonia, there are many cases in which a pneumonia or broncho-pneumonia, which presents very much the same symptoms, follows other illnesses, e.g. scarlet fever, measles, typhoid, in fact, most of the acute infective fevers may be followed by this disease

### **Pyæmia and Septicæmia (Blood Poisoning)**

An acute disease caused by the invasion of the blood by septic organisms

CAUSE Ordinarily the condition is caused by the spread of organisms growing locally in the body, so that they invade the blood stream in large numbers and cause acute symptoms, owing to the poisons (toxin) they produce

In simple cases of wound, or other local (e.g. throat) infection, the spread of the organisms is prevented by the natural protective action of the tissues and the white blood corpuscles, but if the balance between the two is adversely upset, i.e. if either the resistance of the patient to a moderately virulent organism is lower than normal, or if the virulence of the organism is very high and the resistance of the patient only normal, the organisms are not kept in check, and invasion of the blood stream occurs. This is known as *Septicæmia*

*Pyæmia* is a condition in which not only is the blood stream invaded, but the organisms become deposited in scattered parts of the body, and lead to multiple abscess formation. In the very acute forms of septicæmia, therefore, the patient dies before the abscesses of pyæmia have time to be formed. The danger of pyæmia lies in the gradual exhaustion of the patient's powers of resistance. This may take many months.

SYMPTOMS Rise of temperature, which is very irregular; increase of pulse, flushed appearance; delirium and loss of consciousness, restlessness, attacks of shivering

COMPLICATIONS AND SEQUELAE The sequelae are so numerous that it is impossible to mention them all. It will be understood that where pus is formed, destruction of tissue has taken place,



and, as in pyaemia, this may occur in any part of the body, the results of the disease may be extremely variable. Common sequelae are arthritis, nephritis, endocarditis, pericarditis, cerebral abscess, meningitis.

DURATION Indefinite

### Rheumatic Fever.

A non-infectious acute disease characterized by intense inflammation of the joints.

CAUSE Unknown, excited by exposure to cold and damp.

SYMPTOMS Onset usually sudden. Rise of temperature, acute pains in the joints, the joints being affected one after the other, profuse sweating usually occurs.

COMPLICATIONS Hyperpyrexia (extremely high temperature, up to 108 or 110). *Heart* Endocarditis, myocarditis, and pericarditis may all occur.

Chorea (*q v*), nervous twitchings chiefly of face.

DURATION Extremely variable for six weeks onwards.

### Scarlet Fever.

An acute infectious disease associated with a diffuse red rash.

CAUSE Unknown.

INCUBATION One to seven days.

SYMPTOMS Onset is usually fairly sudden. Sore throat and rise of temperature with appearance of the rash on the second day is characteristic.

The acute symptoms last about two weeks, and the rash then disappears, the outermost layers of the skin being then shed (so called "peeling").

COMPLICATIONS Acute nephritis, arthritis, endocarditis; Otitis media, and mastoiditis.

DURATION Three to six weeks.

### Small Pox (Variola)

A highly contagious disease associated with a rash consisting of small pustules.

CAUSE Unknown.

INCUBATION Nine to fifteen days

SYMPTOMS Sudden onset with chill, frontal headache and acute pain in the back and limbs. Rapid rise of temperature, and on the third or fourth day the typical rash develops, consisting of small vesicles which contain clear fluid, and on the seventh to tenth day this becomes converted into pus. Later the pustules so formed dry up and the scabs fall off, leaving frequently a pitted appearance of the skin.

COMPLICATIONS Broncho-pneumonia, albuminuria

DURATION Three to six weeks

Vaccination The importance of this as a protection against small pox cannot be too strongly urged. It is beneficial in two ways, viz (i) in preventing infection in a large number of cases, and (ii) if infection occurs in spite of vaccination, it is generally less severe.

## Syphilis.

CAUSE A general contagious disease starting locally and due to infection by an organism called the *Spirochaeta Pallida*. The mode of infection is almost invariably by sexual intercourse, but direct contact in other ways is equally likely to cause infection.

SYMPTOMS The disease is divided into three stages—

1 Primary 2 Secondary 3 Tertiary

1 *Primary* This is the stage of local infection usually of the genital organs, and is characterized by the development of an ulcer with hard edges (called a *Chancre*).

The symptoms are mild, and were it not for the presence of the chancre would probably pass unnoticed.

The duration of this stage is from six to twelve weeks.

2 *Secondary* At this stage the infection shows general constitutional signs.

The symptoms are slight rise of temperature, sore throat, rash, reddish brown in colour, and more marked on the trunk and front of the arms, iritis, loss of hair, warty growths in armpits, groins and between the toes.

The duration is indefinite.

3 *Tertiary* Characterized by the development of local areas of inflamed tissue, each one being called a *Gumma*.

The symptoms. As the gummata may develop anywhere in the body, the symptoms of this stage are innumerable. Any organ of the body may be affected and give rise to symptoms.

The characteristic features of the gumma are the ulceration formed when the mass of inflamed tissue breaks down, and the scarring (usually very dense) that occurs when they heal. The scarring gives rise to much local deformity, and if it occurs in the alimentary canal, or in the trachea, these tubes may be so obstructed as to give rise to serious symptoms.

The duration is indefinite.

4 *Late or Para-Syphilitic Disease* Long after all active signs of the disease have disappeared, certain diseases undoubtedly caused by the original infection, may develop. The chief of these are Locomotor Ataxy and General Paralysis of the Insane.

5 *Congenital Syphilis* The disease is transmitted from either parent to their offspring, who may show many of the signs of the secondary and tertiary stages of the disease. Such children are poorly developed physically, and seldom survive to adult age.

COMPLICATIONS AND SEQUELAE. No true complications can be described, but the disease may affect any part of the body, and the sequelae are innumerable, being due to destruction and scarring of the parts by gummata and ulceration. In one sense the para-syphilitic diseases may be called sequelae.

## **Tetanus (Lockjaw)**

CAUSE An infectious disease characterized by spasmodic contraction of the muscles, and caused by a specific organism, the *Tetanus Bacillus*, usually entering the body through a wound.

The bacillus occurs in the soil and in manure.

INCUBATION Ten days.

SYMPTOMS Stiffness of the neck and muscles of mastication, followed by tonic contraction which prevents the jaws being opened. The spasm then extends to the trunk muscles. Temperature rises, and in acute cases death usually occurs from exhaustion after a few days. In subacute or chronic cases the prognosis is better, and the attack, after lasting two or three weeks, gradually subsides.

SEQUELAE Nil.

DURATION Two to three weeks.

## Tuberculosis.

Caused by the invasion of the body by the *Tubercle Bacillus*. This disease exists in a very great variety of forms, as there is practically no organ or tissue of the body that may not be the site of the invasion.

The following are the commoner regions to be affected—

1 *Lungs* (Phthisis) One or both may be affected and the disease may start anywhere, most commonly at the apex of one or other lung.

**SYMPTOMS** (a) *Acute* So-called galloping phthisis. Onset rapid and severe. High temperature, constant cough, rapid wasting, shortness of breath, blood-stained sputum. Duration, two to six weeks (very variable).

(b) *Chronic* Intermittent but persistent cough, scanty expectoration, except in very advanced cases, where the expectoration may be profuse, streaks of blood in sputum, haemoptysis, evening rise of temperature, loss of weight and pallor, general debility, shortness of breath on exertion; night sweats. Duration indefinite.

**COMPLICATIONS AND SEQUELAE** Pleurisy, destruction of lung tissue causing cavities, adhesions between lung and chest wall, general ill-health owing to deficient oxygen supply to blood, pleural effusion and empyema.

### 2 *Pleura* (Pleurisy)

**SYMPTOMS** Sharp pain in side of chest, especially on breathing, due to rubbing of roughened pleura. Fluid may be present in the chest, either clear or infected (Empyema). Duration indefinite.

### 3 *Peritoneum* (Peritonitis)

**SYMPTOMS** Abdominal pain varying in intensity and position. Abdomen is usually distended. There may be either diarrhoea or constipation. Wasting. Duration indefinite.

### 4 *Joints* Any joint may be affected. May follow injury.

**SYMPTOMS** Swelling of joints, skin usually pale and oedematous. Pain often marked at night when patient drops off to sleep. Wasting of affected limbs.

**SEQUELAE** Deformity of joint. Stiffness or complete ankylosis may result or the joint may become completely disorganized and amputation may be necessary. The patient may die of general

toxaemia due to absorption of toxin from the site of infection (Lardaceous or Amyloid disease) Duration From three months upwards

5 *Bones* (Osteitis) The tubercle usually starts at the ends of the long bones and leads to a chronic abscess in the bone Infection of the neighbouring joint may occur When affecting the fingers, as is frequent in children, it is termed *Dactylitis* May follow injury

SYMPTOMS. Pain and swelling at the site of the infection X-ray shows clear space within the bone, due to abscess Duration indefinite—frequently extremely prolonged

COMPLICATIONS AND SEQUELAE Infection of neighbouring joints Sinus formation

#### 6. *Kidneys* (Nephritis)

SYMPTOMS Pain in loin, slight increase in temperature, frequency of micturition—wasting, occasionally blood in urine (haematuria) Duration indefinite May need operative treatment

COMPLICATIONS Cystitis, pyonephrosis, perinephric abscess

#### 7 *Bladder* (Cystitis)

SYMPTOMS Pain and frequency of micturition Diagnosis is made by the discovery of tubercle bacilli in the urine, and by interior examination of the bladder Duration indefinite, very chronic

This condition is frequently the result of kidney infection spreading from above, or infection of the epididymis spreading from below

SEQUELAE. Tubercular Nephritis

8 *Epididymis* (Epididymitis) *Symptoms* Pain and swelling of the epididymis, sometimes associated with an infection of the testicle (Orchitis) In late stages abscesses may form in the testicle or epididymis and discharge through the skin of the scrotum Removal of the testicle may be necessary

SEQUELAE Cystitis, prostatitis

9 *Skin* (Lupus) The common form of skin disease due to tubercle is that known as *Lupus Vulgaris* It usually occurs on the face near the nose

SYMPTOMS Ulceration of the skin Scarring takes place at certain spots on the margin of the ulcer and the disease spreads at other spots The scarring is very thin and papery The ulceration may spread deeply and cause much deformity

Another form of lupus is known as *Lupus Erythematosus*, is not accompanied by ulceration, but the skin is usually inflamed on the cheeks on each side of the nose Duration indefinite

SEQUELAE Nil, except deformity due to scarring

10 *Brain and Meninges* (Encephalitis and Meningitis)

SYMPTOMS Headache, fits, vomiting, loss of visual acuity In late stages delirium and loss of consciousness The fits vary in character and severity according to the part of the brain chiefly affected If this is near the "Motor Area" the fits may be epileptic in character Duration indefinite

SEQUELAE Persistent fits, headache It is usually fatal

With regard to "Surgical" tuberculosis, i.e. tuberculosis other than pulmonary, it should be remembered that, generally speaking, the disease is long drawn out, and is characterized in the later stages by the development of "cold" abscesses, i.e. abscesses unassociated with the symptoms of heat, and acute tenderness and redness of the skin which are met with in acute septic abscesses; and that if the patient dies, it is frequently due to gradual exhaustion following long continued toxæmia (Amyloid or Lardaceous disease)

EFFECT OF INJURIES ON TUBERCULAR CONDITIONS This is very important from the medico-legal point of view There is probably no form of tuberculosis that has not at one time or another been alleged to have been caused by injury The argument is that an injury usually results in a local lowering of the resisting power of the tissues to invasion by any organism

As the tubercle bacillus is extremely common and may be present in the blood stream in small numbers without giving rise to symptoms, this locally lowered resistance may be the determining factor in providing these stray organisms with a chance of growing, and so causing local tubercular disease

There is no doubt that tubercular disease of bones and joints may be so caused or aggravated If it is alleged that such is the case, a medical examination should be made at once, as the only means of disproving it is by showing that the condition present is too advanced, or not advanced enough, to have been caused by the injury It is almost impossible to disprove aggravation of a pre-existing tubercular condition unless the patient's history can be demonstrated to be false

## Typhoid.

**CAUSE** A general infection due to *Bacillus Typhosus*, characterized usually by acute intestinal symptoms. The disease is usually transmitted by direct contact with patients—usually when nursing—from the excreta, by the germ being conveyed from a contaminated source in the food, or by flies. As Professor Osler alliteratively expressed it, “Fingers, food, and flies are the chief source of local propagation.” Food and flies may become infected from sewage.

**INCUBATION** Eight to fourteen days

**SYMPTOMS** As the disease may give rise to most varied symptoms, it is one of the difficulties of medicine to determine the diagnosis, as the symptoms may simulate many other illnesses. The characteristic symptoms are headache, loss of appetite, diarrhoea (sometimes constipation), vomiting, abdominal tenderness and distension; increasing and irregular temperature, enlargement of spleen, and a rash of rose-coloured spots.

The symptoms increase during the second week, and mental symptoms, delirium, and mental torpor frequently occur.

**COMPLICATIONS** Nephritis, haemorrhage from bowels, perforation of the bowel, pneumonia, meningitis; periostitis.

**DURATION** Three to six weeks

## Typhus

**CAUSE** An acute infectious disease, caused by organism not known.

**INCUBATION** Twelve days or less

**SYMPTOMS** Onset accompanied by chill, headache, and pains in the limbs. Prostration is marked, high temperature and pulse, vomiting, delirium, rash appears on the third to fifth day. At the end of the second week a crisis occurs, and the temperature comes down suddenly to normal.

**SEQUELAE.** Nil

**DURATION** Three to five weeks

## Vaccinia (Vaccination)

Vaccinia is a disease popularly called cow-pox, and is of interest in that if a human subject is inoculated with the disease, it affords a protection against small pox. Vaccination is performed by

inoculating the subject with the lymph from a calf that is infected with vaccinia

**SYMPTOMS** On the third day after inoculation, the skin becomes red, and raised at the site of the inoculation, and these spots become vesicular (showing clear centres) on the fifth or sixth day. These vesicles then become filled with pus, and then dry, forming a scab which falls off on the twelfth or fourteenth day.

**COMPLICATIONS** Chiefly skin infections. Sometimes general symptoms of fever, and abscesses due to general infection in weakly subjects.

**DURATION** Ten to fourteen days

### Whooping Cough (Pertussis)

A highly infectious disease, characterized by respiratory symptoms and a convulsive cough ending in a long-drawn "whoop."

**CAUSE** Unknown

**INCUBATION** Seven to ten days

**SYMPTOMS** Onset, running from nose and a cough which is very persistent. Later the "whoop" develops, cough now characterized by a series of short coughs during which the patient takes no breath, and at the end of which he inspires, and owing to some spasm of the glottis, makes the characteristic "whooping" noise. Vomiting frequently occurs after the paroxysm.

**COMPLICATIONS AND SEQUELA** Haemorrhage from the nose, or into the eyes may occur, convulsions, bronchitis, pneumonia.

**DURATION** Six weeks

### Yellow Fever.

**CAUSE** A fever known only in tropical and subtropical countries. Characterized by jaundice, transmitted by the mosquito.

**INCUBATION** Three to four days

**SYMPTOMS** Rise in temperature and pulse, yellowness of skin, albumen in urine, vomiting frequently of blood.

**SEQUELAE** Nil

**DURATION** One to three weeks



## CHAPTER XXII

### DISEASES OF THE RESPIRATORY SYSTEM

#### Asthma.

A DISEASE characterized by attacks of breathlessness and violent spasmodic respiratory efforts

CAUSE Unknown Frequently due to some irritant of mucous membrane of the nose, e g deformities of the nasal cartilages In other cases dust or pollen may excite an attack, or it may be purely nervous

SYMPTOMS Want of breath, violent and spasmodic efforts at respiration, dry cough, followed after a few minutes by profound exhaustion

COMPLICATIONS AND SEQUELAE Chronic bronchitis and emphysema of the chest

DURATION Attacks are frequently continuous for a few days (four or five), and then weeks may pass before another occurs Recurrence is almost inevitable.

#### Bronchitis.

A disease of the lungs characterized by persistent cough with expectoration

CAUSE Irritation of mucous membrane of the lungs by cold or dust.

SYMPTOMS Shortness of breath, cough, expectoration, feeling of tightness in chest The condition may be *acute*, when the temperature is raised This is more common in young persons

DURATION Two to three weeks, or *chronic* occurring in elderly patients, and may last indefinitely with remissions of varying duration

COMPLICATIONS AND SEQUELAE Emphysema of lungs, heart disease, broncho-pneumonia—a form of pneumonia (*q v*)—usually occurs in children, following the children's fevers, measles, scarlet fever, etc

**Broncho-pneumonia.** (See also *Pneumonia*, Chap XXI)

Acute inflammation of the lungs There are two common varieties (i) Lobar pneumonia (*qv*), (ii) Broncho-pneumonia

*Broncho-pneumonia* Inflammation of the smaller air passages in the lungs

**CAUSE** Cold and exposure, follows the specific fevers of children, may be due to inhalation of foreign matter into the lungs, e.g. fluids or foreign bodies

**SYMPTOMS** As for pneumonia, except that the sputum is not bloodstained, blueness of the skin

**SEQUELAE** Empyema, abscess of lung, pleurisy

**DURATION** Two to eight weeks

**Coryza** (Cold in Head)

**CAUSE** Infection of the nasal mucous membrane by bacteria

**SYMPTOMS** Feeling of stuffiness and running from the nose, irritation of throat if extension takes place there

**COMPLICATIONS** Laryngitis, chronic nasal catarrh nasal sinusitis

**DURATION** Three to ten days

**Emphysema** (of Lungs)

A mechanical condition of dilation of the air passages, and alveoli of the lungs accompanied by a chest wall that is rigid and capable of only very small respiratory movements

**CAUSE** Persistent and chronic coughing causing continuous increase of pressure on the alveoli, resulting in their distension. The loss of elasticity in the tissues in old age makes elderly people extremely liable to the condition

**SYMPTOMS** Shortness of breath, "barrel-shaped chest", small range of respiratory movement, frequently associated with chronic bronchitis

**COMPLICATIONS** Chronic bronchitis

**DURATION** The condition is permanent and is likely at any time to give rise to the above symptoms

**Empyema** (literally a collection of pus)

Empyema of the chest is a condition in which a collection of pus develops between the lung and the chest wall

**CAUSE.** Infection of the *Pneumococcus* (in pneumonia), *Streptococci* (septic organisms), and the *Tubercle Bacillus*

**SYMPTOMS** Increase of temperature, pulse, and respiration rates; sweating, usually pain in chest and dyspnoea (shortness of breath)

**SEQUELAE.** Pyaemia, adhesions of pleura, collapse of lung which may not again expand

**DURATION** Until the pus is removed by operation, subsequently the wound may discharge and convalescence be prolonged for weeks or months.

### Hay Fever.

**CAUSE** An irritation of the mucous membrane of the nose, due commonly to pollen from hay or flowers

**SYMPTOMS** Those of a severe cold, headache may be marked, running from the eyes and repeated paroxysms of sneezing are characteristic

**SEQUELAE** Nil

**DURATION** One to three weeks, usually recurring regularly during the summer

### Laryngitis.

Inflammation of the larynx

**CAUSES** These are very many Chief of them are irritation due to dust or infection from a cold, overuse of the voice, inhalation of tobacco smoke, tubercle, syphilis

**SYMPTOMS** Hoarseness or loss of voice, irritating cough If ulceration takes place as in tubercle and syphilis, pain may be marked

**SEQUELAE** Persistent hoarseness, bronchitis, pneumonia

**DURATION.** (i) Acute, three to ten days, (ii) Chronic, indefinite

### Pleurisy.

Inflammation of the pleura covering the lung, and lining the chest wall Frequently associated with the collection of fluid in the chest

**CAUSES** Exposure to cold; acute lung diseases, e g pneumonia, the tubercle bacillus

**SYMPTOMS** Breathlessness, acute stabbing pains in chest on breathing, increase of temperature (sometimes)

**COMPLICATIONS** Effusion of fluid into chest, empyema

**DURATION** Ten days to several weeks

**Pneumothorax** (a collection of air between the lung and the chest wall)

**CAUSES** Penetrating wounds of the chest, perforation of the lung through disease. Clear fluid may be present with the air (*Hydro-pneumothorax*), or pus with the air (*Pyo-pneumothorax*)

**SYMPTOMS** Apart from those due to the cause of the pneumothorax, the only striking symptoms are *Dyspnoea* (breathlessness), rapid pulse, and blueness of the skin

**SEQUELAE** Collapse of lung, embarrassed heart's action, others due to the specific cause of the pneumothorax

**DURATION** From one week onwards. Very often fatal and may need operation

**Pulmonary Haemorrhage** (Haemoptysis)

Haemorrhage from the lungs is not a disease but a symptom

**CAUSE** It must be appreciated that many patients "cough up blood" when there is no disease of the lungs at all. In these cases the blood may come from the back of the throat or from the nose. In the latter case, the blood may trickle down to the throat, cause irritation, and be coughed up (For causes of this condition see *Epistaxis*)

Haemorrhage if from the lungs is commonly due to two conditions, tubercle and aneurism of the aorta—more rarely to heart disease and bronchiectasis

Cases do occur, however, in which slight, "streaky" haemorrhage may occur and no tubercle be found in the lungs either at the time or later on. Such attacks do not as a rule recur, and their cause is unknown

**SIGNIFICANCE OF HAEMOPTYSIS** If occurring in tubercular patients, the haemorrhage, if marked, usually indicates active disease, as it is due to rupture of a blood vessel which has become eaten away by disease. It is also of bad import in that it is

frequently the means of spreading the tubercle bacillus from one part of the lung to another

In cases of aneurism, the haemorrhage is usually fatal, but cases occur in which, owing to the pressure of the growing aneurism on surrounding blood vessels in the lung, these are so weakened as to give rise to bleeding, which may cease and recur later on

**STRAIN AS A CAUSE OF HAEMOPTYSIS.** This is frequently alleged. It must at once be admitted that if a lung is diseased and the blood vessels weakened, a sudden strain by increasing the blood pressure may precipitate an attack of haemorrhage. Such haemorrhage will show itself *at once*, and if a delay of more than a few minutes occurs, the possibility of the strain having caused the haemorrhage must be denied.

The only possible exception is in the case of a lung with a large cavity in it. In these cases haemorrhage from a strain may cause bleeding into this cavity and the blood may remain there for a few hours before it is coughed up.

Strain may cause rupture of an aneurism, and in this case the haemorrhage will be immediate and almost invariably fatal.

## CHAPTER XXIII

### DISEASES OF THE CIRCULATORY SYSTEM

**Anaemia** (literally bloodlessness    Poorness of blood)

It may be primary or secondary, i.e. may be due to a primary abnormality of the blood, or to a diminution in the concentration of the albuminous fluid of the blood, and in the number of blood cells, secondary to some other disease

**CAUSES OF SECONDARY ANAEMIA**    Haemorrhage, blood poisoning (Septicaemia), chronic poisoning from lead, mercury, and arsenic, chronic nephritis

**SYMPTOMS**    General debility, indigestion, breathlessness, palpitation, fainting attacks

**SEQUELAE**    Persistent ill-health and general debility

**DURATION**    Indefinite

### **Aneurism.**

A local dilatation and enlargement of an artery

**CAUSES**    Weakness of the artery owing to disease (commonly syphilis)

**SYMPTOMS**    Depend entirely on the position of the aneurism  
The commonest site is in the aorta, and the symptoms due to this are pain in chest, dyspnoea, cough, possibly blood-stained expectoration

**COMPLICATIONS**    Pressure on the lungs may give rise to bronchitis and consolidation of the lung, pressure on bones may give rise to erosion of the bone, haemoptysis may occur in small or large quantities, death may be caused by rupture of the aneurism

**DURATION**    Indefinite

### **Angina Pectoris.**

An affection of the heart, characterized by attacks of violent spasmodic pain in the cardiac region

**CAUSE**    Unknown    Frequently associated with high blood pressure (See *Arterio-sclerosis*)

**SYMPTOMS** Agonizing pain in the region of the heart, radiating to the neck and down the arm ; pallor of face ; feeling of impending death

**SEQUELAE** Nil

**DURATION.** Each paroxysm lasts a few minutes. The patient may then feel well within an hour or two, or a day or two. The first or any subsequent attack may prove fatal, and the patient may live for several years with intermittent attacks

### Arterio-sclerosis.

Thickening of the arteries with loss of elasticity.

**CAUSES** Commonly old age ; excessive muscular work ; syphilis ; chronic poisoning, e.g. lead, alcohol ; kidney disease

**SYMPTOMS** These vary with the region of the body chiefly affected, and are, as a rule, either cardiac or cerebral. The common cardiac symptoms are dyspnoea, anginal attacks ; pallor

Cerebral symptoms may be passing paralysis, vertigo (giddiness).

General symptoms—those of old age.

**COMPLICATIONS** Cerebral haemorrhage (apoplexy) ; hypertrophy and dilation of the heart, aneurism.

**DURATION** The condition is permanent and cannot be cured, though it may be temporarily relieved

### Chlorosis.

A form of primary anaemia, characterized by a yellow-green tinge of the skin. (See *Anaemia*)

### Congenital Heart Disease.

**CAUSE** An abnormality in the development of the heart in which the two halves of the heart are not completely separated.

**SYMPTOMS** Dyspnoea ; blueness ; palpitation. Occurs only in children, who rarely survive after the age of puberty

### Dilatation of the Heart.

**CAUSES** Increase of pressure within the heart, accompanied by weakening of the heart muscle—thus any form of heart disease, kidney disease, and arterio-sclerosis are common causes.

**SYMPTOMS** Shortness of breath ; loss of vigour ; palpitation ; symptoms of the disease of causation

SEQUELAE Nil, apart from the above symptoms which may persist

DURATION. Three or four weeks onwards

### Endocarditis.

Disease of the lining membrane and valves of the heart.

CAUSES Acute rheumatic fever, the infectious fevers; septicaemia and pyaemia (malignant endocarditis, *qv*)

SYMPTOMS Dyspnoea (chiefly on exertion), skin may be blue or flushed, according to the valves affected Increase and irregularity of pulse, palpitation of heart

COMPLICATIONS Dilation and hypertrophy of heart, congestion of lungs, embolism, dropsy, cough and haemoptysis

DURATION Indefinite

### Malignant (or Ulcerative or Infective) Endocarditis.

A severe form of endocarditis (*qv*) in which great destruction of the valves may occur by ulceration and in which outgrowths of granular tissue (vegetations) develop

CAUSE It may follow a simple endocarditis, but is more commonly due to acute infection by septic organisms or the gonococcus, and is liable to develop whenever infection by these organisms has occurred in any part of the body and has lasted for some time

SYMPTOMS Irregular rise of temperature, sweating, delirium, flushing of the face and rapid pulse

COMPLICATIONS The vegetations may separate from the valves of the heart and form emboli Other complications, e.g. pyaemia, are really complications of the cause of the endocarditis.

DURATION It is a very fatal disease, and may be in itself an indication of a severe general septic infection If recovery takes place, the valves of the heart are so damaged as to give rise to permanent invalidism

### Pericarditis (Inflammation of the pericardium)

CAUSES Usually following rheumatic fever, scarlet fever, pneumonia, septicaemia

SYMPTOMS Simple pericarditis shows no symptoms except



perhaps pain in the chest If effusion of fluid, either clear (hydro-pericardium) or pus (pyopericardium) is present, symptoms of cardiac embarrassment, viz dyspnoea, blueness, palpitation, are most prominent

**SEQUELAE** Adhesions between heart and pericardium, giving rise to dyspnoea and pain in chest on exertion

**DURATION** Indefinite If effusion is marked it is very frequently fatal

### **Pernicious Anaemia.**

A form of anaemia associated with destruction of red blood cells and the presence in the blood of abnormally-shaped red cells

**CAUSE** Unknown

**SYMPTOMS** Gradually increasing general weakness, pallor, especially of gums and lips, palpitation of heart

**COMPLICATIONS** Nil

**DURATION** Two to ten or twelve months Almost invariably fatal, after, in some cases, temporary improvement Patients may be kept alive by blood transfusion, but cures are rare.

### **Raynaud's Disease.**

A disease of the circulation characterized by defective circulation through the finger tips and other extremities

**CAUSE** Unknown

**SYMPTOMS** Pallor and coldness of the finger tips followed by burning and redness (similar to frost bite), acute pain may be present; nails may be shed, and local gangrene may occur.

**COMPLICATIONS** Stiffness and thickening of the finger joints may occur Various nerve complications, such as neuritis and even epilepsy, have been described

**DURATION** Indefinite May occur in attacks which last a few weeks and recur at irregular intervals indefinitely.

### **Tachycardia (Rapidity of heart beat)**

This is not a disease in itself, but a symptom of a variety of diseases As, however, it may be the only symptom, the term Tachycardia is frequently loosely used, as though it were a disease The probable explanation of the occurrence of tachycardia without

obvious cause is that it is due to some abnormality of the heart muscle, or nerves supplying the heart. It is frequently associated with general neurasthenic symptoms. Exophthalmic goitre is a common cause.

DURATION Indefinite

### Valvular Disease.

Inflammation leading to thickening and deformity of one or more of the valves of the heart, allowing the blood to regurgitate during the beating of the heart. (See *Endocarditis*.)

## CHAPTER XXIV

### DISEASES OF THE GENITO-URINARY SYSTEM

#### **Albuminuria** (Albumen in urine)

THIS may be of no significance, as it frequently occurs as a transient phenomenon in patients of advancing age, or in adolescence. It is the cardinal symptom of Bright's disease (acute and chronic nephritis). It may occur during any high fever.

**CAUSE** Imperfect performance of the function of the kidney due to—

- 1 Any inflammatory condition of the kidney.
- 2 Defective arteries, e.g. in old age
- 3 Chronic general disease, e.g. syphilis, toxæmia.
- 4 Acute general infections

**SYMPTOMS** Albuminuria in itself is a symptom, and gives rise to no symptoms except those of a secondary anaemia. The symptoms and sequelae associated with it are those of the disease to which it is due.

#### **Bright's Disease.**

Acute or chronic inflammation of the kidneys (nephritis).

**CAUSE** Unknown. Frequently initiated by a chill.

##### *Acute*

**SYMPTOMS** Blood in urine (haematuria), urine scanty, pain in back, increase of temperature, anaemia, dropsy, uraemia due to suppression of urine, and characterized by unconsciousness and the development of fits may be a terminal symptom.

**SEQUELAE** Chronic nephritis

**DURATION** One to three months

*Chronic* May follow acute nephritis.

**SYMPTOMS** Albuminuria, dropsy, high tension pulse, urine may be diminished in early stages, but later may be increased above normal in amount, dyspepsia, anaemia, enlargement of heart.

**COMPLICATIONS** Cerebral haemorrhage, uraemia (*q.v.*), loss of vision due to haemorrhage into retina; oedema of the lungs, and bronchitis.

**DURATION** Indefinite

**Calculus, Renal (Stone in kidney)**

**CAUSE** By deposits of crystals from the urine in the kidney. The reason for this in most cases is unknown. It may be associated with a concentrated urine, or may follow inflammatory conditions of the kidney, and in some cases injury, it being probable in the last case that the nucleus of the stone is formed by a minute blood clot or organized fibrous material.

**SYMPTOMS** Pain in loin either aching or sharp and shooting (renal colic), frequency of micturition, haematuria. Can be detected by X-ray examination.

**COMPLICATIONS** Kidney infection by organism (nephritis), pus in kidney (pyonephrosis), suppression of urine; uraemia.

**DURATION** Indefinite, until the calculus is removed by operation. Recovery should take place in eight to ten weeks after operation.

**Calculus in Ureter (Ureteric Calculus).**

**CAUSE** The attempt to pass the stone from the kidney into the bladder.

**SYMPTOMS AND SEQUELAE** Similar to those of renal calculus.

**Calculus in Bladder (Vesical Calculus)**

May be passed from the kidney into the bladder, or formed independently in the bladder. Sometimes follows operations on the bladder and cystitis (inflammation of the bladder).

**CAUSE** Unknown. Due to the deposit of urates, uric acid, or oxalates. May follow cystitis.

**SYMPTOMS** Frequency of micturition; pain on micturition, usually at end of the act, blood in urine, pus in urine.

**COMPLICATIONS** Cystitis (*q v*), inflammation of kidneys spreading up from the bladder, orchitis and epididymitis in the male; retention of urine if the stone gets fixed in the urethral orifice of bladder, suppression of urine.

**DURATION** Indefinite. Eight to ten weeks after operation.

**Calculus of Urethra.**

A small vesical calculus may get impacted in the urethra and give rise to acute pain with retention of urine.

**COMPLICATIONS** As for vesical calculus.

**Cystitis** (Inflammation of the bladder)

**CAUSES.** Chill; tubercle, calculus, infection from urethra or testicles, infection from kidney, enlarged prostate, stricture of urethra

**SYMPTOMS** Frequency and pain in micturition, pus and mucus in urine, foul smelling urine, symptoms associated with the primary cause

**COMPLICATIONS** Spread of infection to prostate and testicle or to kidneys

**DURATION** Indefinite

**Epididymitis** (Inflammation of epididymis)

Causes and symptoms similar to orchitis

**Haematuria** (Blood in urine)

This is not a disease but a symptom of many diseases. If the blood is bright red, it usually indicates that its source is from the bladder. If the urine is well mixed with the blood and is of smoky appearance, it usually indicates kidney disease.

**COMMON CAUSES** Acute Bright's disease, renal or vesical calculus, growth of the kidney or bladder, cystitis, enlarged prostate, injury to any part of urinary tract

**SEQUELAE** Anaemia. Others due to the specific cause of the haematuria

**DURATION** Dependent entirely on nature of cause

**Hydrocele.**

A collection of clear fluid between the testicle and its coverings

**CAUSE** Frequently arises spontaneously. May be caused by syphilis. Rarely occurs with tubercle. If an injury is followed by a collection of fluid round the testicle, this is almost invariably blood (haematocoele) and not a hydrocele.

There is no definite evidence to show that a hydrocele can be caused by a strain, although frequently a strain may draw the man's attention to the condition of whose pre-existence he may have been ignorant.

**SYMPTOMS** Swelling in the scrotum with a dragging pain in groin

**DURATION** Indefinite In cases of small hydrocele the symptoms are usually relieved at once by wearing a suspensory bandage. Large hydroceles may be tapped at intervals and the fluid withdrawn, or an operation performed for their cure.

Disability following operation two to three weeks.

### **Hydronephrosis** (literally water in the kidney)

**CAUSE** Obstruction of the ureter, whereby the urine, although secreted, cannot be passed into the bladder, and so gradually accumulates in the upper part of the ureter and pelvis of the kidney, causing sometimes enormous distension of this part of the urinary tract, and so giving rise to a tumour containing urine in the loin. Commonly due to calculus or congenital abnormality of ureter.

**SYMPTOMS** Pain in back, presence of swelling in loin, occasional passage of excessive quantity of urine, if the hydronephrosis empties itself.

**COMPLICATIONS** Pyonephrosis, suppression of urine, nephritis.

**DURATION** Indefinite. Operation may lead to cure or to the formation of a fistula (track from the kidney to the surface of the skin through which urine may continue to pass).

### **Movable Kidney (Nephroptosis)** (Dropped or floating kidney)

The kidney, instead of remaining in its normal position, may become dropped and abnormally mobile.

**CAUSE** May be part of a general dropping of the abdominal contents (*Visceroptosis*) due to relaxation and weakness of the abdominal muscles. Injury, such as a sudden twist or jar, or a blow in the loin, may be the exciting cause.

**SYMPTOMS** Pain in back, dyspepsia; general nervous symptoms, frequently associated with neurasthenia.

**SEQUELAE** If associated with kinking of the ureter, hydronephrosis and pyonephrosis may follow.

**DURATION** Indefinite. Operation is sometimes successful in fixing the kidney (incapacity eight to twelve weeks after operation). Is frequently the cause of chronic ill-health.

**Nephritis** (Inflammation of kidney).

**CAUSE.** Apart from Bright's disease (*q v*), the condition may be caused by calculus (*q v*); tubercle, septic infection (frequently from organisms in the large bowel, e.g. *Bacillus Coli Communis*).

**SYMPTOMS** Pain in loin, frequency of micturition, haematuria; increase in temperature, pus in urine. Other symptoms due to the exciting cause.

**COMPLICATIONS** Cystitis, suppression of urine, pyonephrosis, septicaemia, wasting.

**DURATION.** Indefinite.

**Orchitis** (Inflammation of testicle)

**CAUSES.** Venereal disease (gonorrhoea, less commonly syphilis); tubercle, infection from inflammation of bladder or prostate. Injury by direct blow or twist. Sometimes a complication of fever, e.g. scarlet fever, mumps.

**SYMPTOMS** Enlargement and tenderness of the testicle, dragging pain in groin.

**SEQUELAE.** Cystitis; abscess of the testicle, enlargement of glands in groin or abdomen.

**DURATION.** If due to injury, one to six weeks, if to tubercle, it is very intractable and may last for months unless operated on, and even then a complete cure may be impossible.

**Perinephric Abscess** (Abscess round the kidney)

**CAUSES.** Infection of the tissues round the kidney from the bowel; renal calculus, spread of infection from the kidney to the surrounding tissues, e.g. nephritis due to tubercle or a septic infection.

**SYMPTOMS.** Pain in loin, increase of temperature and pulse, symptoms of cause.

**SEQUELAE** Persistent discharge from sinus in that loin, urinary fistula.

**DURATION** Indefinite, six weeks to six months after operation.

**Prostate, Enlargement of.**

**CAUSES.** Old age; it is one of the commonest causes of urinary troubles in elderly men. Symptoms are caused by irritation of the

base of the bladder and by obstruction to the flow of urine through the urethra This may be due to general enlargement of the gland, or to contraction of the gland owing to the development in it of fibrous tissue Other causes are new growths, malignant or innocent, adenoma

**SYMPTOMS** Frequency of micturition, difficulty in passing water, pain on passing water, haematuria, constipation

**COMPLICATIONS** Cystitis; nephritis; retention of urine, vesical calculus

**DURATION** Indefinite Complications and incapacity may be prevented in early stages by medical treatment and catheterization Prostate may be removed by operation followed by recovery in two to six months Operation known as *Prostatectomy*

### **Prostatitis (Inflammation of Prostate).**

**CAUSES** Infection from septic organism, or due to calculus in the prostate, gonorrhoea, tubercle

**SYMPTOMS** As for enlargement of prostate, and in addition, there may be great pain on defaecation, pyuria

**COMPLICATIONS** Cystitis, nephritis, orchitis, epididymitis

**DURATION** Three to twelve weeks

### **Pyelitis.**

Inflammation of the pelvis of the kidney (junction of ureter with kidney)

**CAUSES** May be primary, probably by infection from the large bowel which is in close contact with it, or secondary to calculus, cystitis or other infection of urinary tract It is sometimes associated with pregnancy without any other apparent cause

**SYMPTOMS** These are usually due to the accompanying cystitis or nephritis, e.g. frequency of micturition, pain in loin

**COMPLICATIONS** Cystitis, nephritis; pyonephrosis, pyuria

**DURATION** Indefinite, may be very intractable

### **Pyuria (Pus in urine).**

**CAUSES** Infection of kidney, ureter, bladder, or prostate

**SYMPTOMS** Frequency of micturition If very marked, there is usually pain on micturition as well Also symptoms of the cause



SEQUELAE Dependent on cause

DURATION Dependent on cause May be very intractable

### Uraemia.

Generalized symptoms due to retention of toxic material in the blood, which should be excreted by the kidneys

CAUSES Disease of kidney (Bright's disease and others)

SYMPTOMS Vomiting, drowsiness, loss of consciousness, fits, diminished urinary secretion, dyspnoea

SEQUELAE Nil May be fatal within a few days

DURATION. Acute—a few days Chronic—indefinite

### Urethra (Stricture of).

CAUSE Chronic urethritis (gonorrhoea *q v*) or injury. The commonest cause is the former. The most usual injury to give rise to stricture is a fall with the legs apart across a beam, in which case the urethra is ruptured and when scarring occurs constriction may take place

SYMPTOMS Difficulty in passing water which comes in a small stream

COMPLICATIONS Retention of urine if the stricture is complete, cystitis due to decomposing urine either because the bladder is not effectively emptied and so the urine stagnates, or else infection may be carried in by careless use of catheter, urethral abscess

DURATION Depends entirely on the degree of constriction present. As the treatment usually consists of dilation or stretching by passing catheters of increasing size, the tighter the stricture the longer will it take to dilate it

It may take weeks to dilate a stricture effectively. On the other hand, a stricture of itself does not cause disability, so that unless any of the above-mentioned complications are present it cannot be said to be disabling unless an operation is necessary. In these cases the patient will be incapacitated from work for two to three weeks.

### Urethritis (Inflammation of Urethra)

CAUSES Most commonly gonorrhoea, but may be due to septic infection.

SYMPTOMS Urethral discharge and burning pain on micturition

COMPLICATIONS Urethral abscess, cystitis, epididymitis (See *Gonorrhoea*)

DURATION Acute Five to fifteen days Chronic Indefinite.

## Uterus.

### *Displacements*

The normal position of the uterus is tilted forwards and bent forwards again at the junction between the neck and body. A great many varieties of displacements are possible, the commonest being—

1 RETROVERSION (tilted backwards), so that the fundus or upper end of the uterus lies against the rectum

This may be associated with a bending backwards (Retroflexion) of the body on the neck

2 PROLAPSE, or dropping of the uterus

This may be partial when the uterus remains within the vaginal orifice, or complete when it projects outside

CAUSE Frequently due to childbirth accompanied by tearing of the muscles of the floor of the pelvis, whose support is therefore weakened and the pelvic contents drop down. Tumours of the uterus may cause displacement

Injuries, such as falls or sudden strains of the abdominal muscles, may be followed by uterine displacement

SYMPTOMS Pain in back, dragging pains in the pelvis, Abnormalities of menstruation and vaginal discharge (*Leucorrhoea*)

COMPLICATIONS Constipation and frequency or difficulty in micturition, neurasthenia, metritis (*q v*)

DURATION Indefinite. Can be relieved either by operation or by the wearing of special supports (pessaries). A woman who has once suffered a displacement of this sort, particularly if of advancing years, and if the pelvic floor is weak, is hardly likely to be able to undertake heavy work again

### *Metritis*

Inflammation of the uterine wall and lining (Endo-metritis)

CAUSES May be due to displacement, infection from blood stream, venereal disease. May follow childbirth. May be acute or chronic

**SYMPTOMS** Vaginal discharge; rise of temperature in acute form, and pelvic pain. In chronic form there is persistent vaginal discharge and menstrual disturbance with dragging pains in pelvis.

**COMPLICATIONS** General debility, anaemia, neurasthenia

**DURATION** Acute One to three weeks, usually followed by the chronic form. Chronic Indefinite. Frequently needs operation, when the condition may clear up in two or three weeks. The disability is usually due to the complications

### *Growths.*

Polypi, Fibroid tumours (Myoma) and Cancer are the commonest

**SYMPTOMS** The symptoms of all these are haemorrhage of varying character according to the growth. Symptoms of pressure on the pelvic organs in the case of large fibroid tumours (some of these may almost fill the abdominal cavity).

In the case of cancer, the usual symptoms are present, e.g. wasting, local pain, appearance of secondary growths in the abdomen

**DURATION** Symptoms and disability will persist until the growth (whatever its nature) is removed. This, in the case of polypi, can usually be done without removing the uterus, but in cases of large fibroid growths and cancer the whole uterus has to be removed

Incapacity following this operation may be from two to four months.

### **Varicocele.**

An enlargement of the veins of the spermatic cord

**CAUSE** Unknown. Usually arises spontaneously. The condition cannot be caused by strain or injury

**SYMPTOMS** Dragging pain and sometimes a neuritic pain in the scrotum and groin. There is a tendency for many patients to become neurotic and to imagine sexual power is affected by the condition. This is very rarely so

**COMPLICATIONS** Occasionally atrophy of the testicle may occur, or haemorrhage from the veins if injured directly or by a sudden strain

**DURATION** Usually the symptoms are relieved at once by wearing a suspensory bandage. In other cases, especially if the patient is neurotic, the only cure is the removal of the veins

Disability following operation, ten to twenty-one days

## CHAPTER XXV

### DISEASES OF THE NERVOUS SYSTEM

#### **Anterior Poliomyelitis (Infantile Paralysis)**

A DISEASE characterized by the destruction of groups of motor nerve cells in the brain, or usually in the spinal cord, and resulting in paralysis of various muscle groups

CAUSE Unknown

SYMPTOMS Onset may be acute, with a mild rise of temperature and muscular pain, or insidious, paralysis or weakness of groups of muscles, usually of the legs or arms

SEQUELAE Contraction of the muscles resulting in deformities, many of the cases of deformity of the limbs in children are due to this cause, e g club foot, dropped foot, paralysis of an arm or hand

DURATION Indefinite The acute stage may last a few days only, but the paralysis may take months to disappear, and usually leaves permanent weakness and deformity

#### **Bell's Palsy.**

A paralysis of the facial nerve on one side.

CAUSE True Bell's Palsy is due to a neuritis from cold, but the facial nerve may be paralysed from many other causes, e g middle ear disease, abscess or inflammation of the brain, and tumours

SYMPTOMS Paralysis of one side of the face with corresponding lack of expression, dribbling at the corners of the mouth from lack of power to close the lips firmly, inability to close the eye on the affected side

SEQUELAE If prolonged the commonest sequela is inflammation of the eye, owing to inability to close the lids

DURATION Seven to eleven days Sometimes much longer, and it may be permanent

#### **Brain.**

##### *Abscess*

CAUSES Infection of the brain tissue by organisms either by direct infection from wounds of the skull, or scalp, or middle ear

disease ; or indirectly from the blood stream in cases of pyaemia or tubercle

**SYMPTOMS** Increase in temperature , headache , fits , vomiting , optic neuritis ; loss of consciousness

**SEQUELAE** Persistence of fits , giddiness , paralysis , dependent on cause

**DURATION** Usually quickly fatal, but may last for several months before acute symptoms set in.

### *Embolism*

The blocking of a blood vessel by a clot of blood, usually coming from the heart.

**CAUSE** Usually due to thrombosis in the veins anywhere in the body, e g in phlebitis

**SYMPTOMS** Sudden in onset , paralysis of one side or part of one side of the body , loss of consciousness may occur , speech may be affected

**SEQUELAE** Permanent paralysis may result

**DURATION** Indefinite

### *Haemorrhage (Apoplexy)*

**CAUSE** Usually due to the spontaneous rupture of a blood vessel owing to its degeneration and to high blood pressure (Apoplexy) Also due to injury of the skull The side of the body affected is opposite to the side of the brain on which the haemorrhage occurs

**SYMPTOMS** Paralysis, area depending on the region of the brain in which the haemorrhage occurs , loss of consciousness , slowing of pulse , inequality of pupils

**SEQUELAE** Persistent paralysis of one side of the body, or part of one side, or of one side of the face ; loss of speech

**DURATION** May prove fatal within a few hours, or the haemorrhage may cease if not very profuse, and the patient may recover in variable time. The duration depends entirely on the region affected, and the severity of the haemorrhage

### *Compression.*

**CAUSES** Haemorrhage , tumour , depressed fracture

**SYMPTOMS** Similar to those of cerebral haemorrhage and abscess (q v )

**SEQUELAE** Persistent headache, fits; paralysis, or other dependent on the cause

**DURATION** Entirely dependent on cause and treatment. If severe is invariably fatal, unless relieved by operation

### *Concussion*

**CAUSES** Blow on the head, or may be due to jarring of the spine, the force being transmitted to the skull

**SYMPTOMS** Headache, loss of consciousness

**SEQUELAE** Persistent headache, sleeplessness, neurasthenia.

**DURATION** From a few minutes to several days, and its sequelae may persist for many months

### *Tumour*

**CAUSE** Unknown, except in cases of a mass of chronic inflammatory material, which is strictly not a tumour, though often called so, commonly due to tubercle

**SYMPTOMS.** As for compression, abscess, haemorrhage (*qv*) All these symptoms are principally due to the compression of the brain or to its irritation

**SEQUELAE** Persistent fits, headache; paralysis

**DURATION** Indefinite, usually fatal

### **Bulbar Paralysis.**

A form of progressive muscular atrophy (*qv*) in which the medulla of the brain is first affected, and difficulty in speaking and swallowing are the initial symptoms

### **Chorea (St Vitus's Dance)**

A disease characterized by jerking, involuntary movements of the muscles of the limbs and face, affecting chiefly children

**CAUSE** Unknown. Frequently associated with a history of rheumatism

**SYMPTOMS** Involuntary jerky movements of the muscles of the face and limbs; speech may be affected; heart symptoms are common, a rapid and irregular pulse being usual

**COMPLICATIONS** Valvular disease of the heart, and persistent mental irritability are common

**DURATION** Ordinary mild cases last ten to twelve weeks Bad cases may last many months

### Disseminated Sclerosis.

A chronic degeneration of the brain and spinal cord

**CAUSE** Unknown

**SYMPTOMS** Weakness and stiffness of legs, with exaggerated knee jerks and an "Extensor plantar reflex" This reflex is elicited by stroking the sole of the foot near the great toe Normally if this is done the great toe is involuntarily flexed In diseases of the central nervous system, the opposite movement may occur, and this is known as the Extensor Plantar reflex, or Babinski's sign

Other symptoms are a tremor of the hands on attempting to use them (*Intention Tremor*), nystagmus (oscillation of the eyeballs, particularly on lateral movements of the eyes)

**SEQUELAE** Nil

**DURATION** Indefinite The weakness of the legs slowly progresses, and after perhaps several years the patient becomes bed-ridden

### Epilepsy. (See also *Petit Mal*)

A disease associated with recurring fits of a characteristic type

**CAUSE** Ordinary epilepsy is of unknown causation, but is frequently associated with a degenerated mental condition, and developmental errors such as cleft palate, etc

Another form of epilepsy follows injury, and is known as—  
**JACKSONIAN EPILEPSY**

**CAUSE** This form is caused by some very slight trauma on the surface of the brain, or of the meninges, whereby a minute scar may be formed, causing slight local irritation of the surface of the brain, and if this is in the "Motor Area" of the brain, it may give rise to typical epileptic fits A blow on the skull, insufficient to cause fracture of the skull, may be sufficient to cause such slight damage Gross damage to the skull and brain may also, of course, produce the same effect

**SYMPTOMS** The characteristic symptom is the "fit" This is a convulsive movement of the muscles which usually starts in one limb and rapidly extends to all the muscles of the body The

patient loses consciousness, breathes stertorously (snoring), and during the convulsions may cause himself injury by striking his head or limbs, or by biting the tongue. The fit is frequently preceded by a premonitory sensation or "aura." This "aura" may be of a variety of kinds, such as a sensation of smell or feeling of discomfort in various parts of the body. The fits are frequently followed by a condition of mental torpor and semi-consciousness lasting for a variable time (an hour or two to one or two days) (*Status Epilepticus*)

SEQUELAE Nil

DURATION Each attack lasts one or two hours to two or three days. Such attacks may recur irregularly, and the duration of incapacity is therefore indefinite.

### Friedreich's Ataxy.

CAUSE Hereditary

SYMPTOMS Loss of normal control of the muscles of the legs. The gait resembles that of a drunken man. Loss of control may affect the arms as well as the head and shoulders, nystagmus.

DURATION Indefinite. The disease is progressive and incurable.

### General Paralysis of the Insane (G.P.I.).

A progressive disease of the brain and meninges, associated with mental degeneration and paralysis.

CAUSE Usually attributed to syphilis.

SYMPTOMS Two stages—

(i) *Irritability*, apathy in business matters, general change of character.

(ii) *Mental excitement*, fits, difficulty in speech; degenerate habits, paralysis of limbs, complete dementia.

SEQUELAE Nil

DURATION Indefinite.

### Hemiplegia.

Paralysis of one side of the body, caused usually by compression of the opposite side of the brain by haemorrhage or tumour. (See *Brain, Haemorrhage*.)

DURATION Four to twelve weeks or permanent.



### Herpes Zoster (Shingles)

This is a specialized form of neuritis, in which the skin supplied by the affected nerve develops small, raised, red spots. A frequent area affected is the distribution of one or more of the intercostal nerves, but the face is a not uncommon area.

CAUSE Unknown.

SYMPTOMS Acute pain along the course of the affected nerve, and the presence of the spots on the skin confined to the area of the distribution of the nerve are typical.

SEQUELAE Nil

DURATION. One to three weeks

### Landry's Paralysis.

A paralysis spreading from the lower limbs upwards, involving the trunk and arms and muscles of respiration.

CAUSE Unknown

SYMPTOMS Progressive weakness of legs, spreading within a few days to the trunk and arms.

SEQUELAE Nil

DURATION Two days to two weeks. Almost invariably fatal.

### Locomotor Ataxy (Tabes Dorsalis).

A disease characterized by degeneration of the sensory roots of the spinal nerves and of the brain.

CAUSE. Syphilis is the commonest, if not the only, cause.

SYMPTOMS Feeling of numbness of the feet, as though walking on cotton wool; inco-ordination in walking; inability to stand upright with the feet close together and the eyes shut (Rhombert's sign), absence of knee jerks, stabbing pains in the limbs and trunk.

SEQUELAE Destruction of joints, indolent ulceration (so-called Trophic sores); paralysis. Chronic ulceration of feet (Perforating ulcer).

DURATION Indefinite. The patient gradually becomes less and less able to walk, and finally becomes bedridden and may be demented.

## Meningitis.

An inflammation of the covering of the brain If of the Dura Mater it is called *Pachymeningitis* If of the arachnoid it is called *Arachnitis* If of the pia mater it is called *Leptomeningitis*

CAUSES Epidemic cerebro-spinal meningitis (*q v*) The meninges frequently become infected by extension from neighbouring parts, e g from the middle ear (otitis media), abscess of the brain, disease of the skull bones Or they may be infected primarily in tubercle or secondarily to a general blood infection from septic organisms, or occasionally from the specific fevers, pneumonia, typhoid, septicaemia A chronic form is sometimes the result of syphilis

SYMPTOMS Headache, delirium, convulsions, rigidity and spasm of muscles, particularly of the neck, vomiting, paralysis of cranial nerves, rise of temperature, frequently without any marked increase of pulse rate

SEQUELAE Persistent headache, neurasthenia

DURATION Indefinite, from three weeks onwards, according to the cause Frequently fatal

## Migraine.

A disease characterized by severe headaches, and visual disturbances

CAUSES Frequently hereditary Any irritation, e g intestinal, teeth, menstrual disturbances, may excite an attack

SYMPTOMS Severe paroxysmal headaches, frequently recurring at regular intervals Nausea and vomiting frequently occur The visual disturbances are usually associated with "Apparitions," i e the patient may see animals of various kinds (rats, mice, etc), or have bright lights, zigzag lines, etc, appear in the eyes

SEQUELAE Nil

DURATION Each attack may last two or three days, but recurrence over many months or years is the common rule

## Neurasthenia (literally weakness of nerves)

A condition of nervous debility, which may be associated with the most variable symptoms, either local or general

CAUSE The underlying cause which renders the nervous system

prone to develop the symptoms of the disease is unknown, but the condition may be excited by a great variety of circumstances, any small abnormality of the bodily functions being liable to precipitate an attack. Thus constipation, slight gastric disturbances, temporary loss of sleep, etc., are often the starting-point. Trauma is a very common cause, and leads the patients to develop an exaggerated idea of the bad effects of some slight injury. Neurasthenia of this sort is sometimes difficult to distinguish from malingering.

**SYMPTOMS** *General* Irritability, emotional disturbances strongly resembling hysteria, tremor of limbs, sleeplessness, loss of appetite, depression of spirits, lack of power of concentration. Pulse rate is frequently increased and knee jerks exaggerated.

*Local* These are innumerable. Local pain may be referred to any part of the body, although no organic abnormality is present to account for it, or if there is a local abnormality, the symptoms are out of all proportion to the abnormal condition. Thus, a man with a trivial injury to a finger or hand may complain of inability to use the affected part, although there is no organic damage to account for it. Pain in the back and an "oppression" felt in the head are common symptoms.

**SEQUELAE** Nil

**DURATION** Indefinite. The removal of any worry, real or imaginary, is the most important means of effecting a cure.

### Neuralgia (literally nerve pain)

Pain localized to the anatomical distribution of one or more of the peripheral nerves. Sciatica and facial neuralgia are the commonest forms.

**CAUSE** Usually some irritation, e.g. defective teeth, local nerve injury or neuritis. Cold may be the exciting cause.

**SYMPTOMS** Persistent and acute pain in the distribution of the nerve.

**SEQUELAE** Nil

**DURATION** A few days to several weeks. Liable to recur.

### Neuritis (Inflammation of a nerve)

**CAUSE** Cold, injury or local septic infection, may follow fevers such as typhoid, diphtheria, influenza, scarlet fever.

poisoning by alcohol, carbon bisulphide and naphtha, lead, arsenic, mercury ; local pressure on nerves, e g crutch palsy in which the pressure of the crutch pad in the armpit may cause loss of power in the forearm

**SYMPTOMS** These are either motor or sensory Motor symptoms are those of paralysis of the muscles supplied, e g dropping of the wrist or foot Sensory symptoms are usually those of pain along the affected nerve, sometimes anaesthesia

**SEQUELAE** Permanent muscular weakness may follow

**DURATION** Indefinite , usually very protracted

### **Paraplegia.**

Paralysis of both arms or both legs

**CAUSE** Usually injury or disease of the spinal cord

**DURATION** Four to twelve weeks or permanent

### **Petit Mal (Minor Epilepsy)**

Sometimes a patient may have momentary loss of consciousness without being aware of it He may be having a meal or doing his work and completely lose himself for a moment or two Under such circumstances he may stare straight ahead, momentarily stop his work, or may perform acts of which he is completely unconscious Such an attack is known as Petit Mal, and may be followed later by true epileptic fits

**DURATION** Each series of attacks may last one to twenty-one days Attacks recur at irregular intervals

### **Progressive Muscular Atrophy.**

A disease characterized by progressive wasting and paralysis of various groups of muscles, usually starting with the small muscles of the hand

**CAUSE** Unknown, but a progressive degeneration of the motor nerve tracts of the central nervous system is always found

**SYMPTOMS** Wasting and weakness of the small muscles of the hand, starting usually with the thumb The wasting and paralysis then extends to the muscles of the forearm and shoulder All reflexes are increased

**SEQUELAE** Nil

**DURATION** Indefinite. The wasting finally affects all the muscles of the body and proves fatal

### **Sciatica.**

Pain, usually due to inflammation of the sciatic nerve, passing from the pelvis down the back of the thigh

**CAUSE** Sciatica is a neuritis (*qv*) and may be attributable to any of the causes of this condition. It is sometimes a symptom of some abnormality within the pelvis, such as a growth or inflammation near the roots of the nerve. In intractable cases, therefore, such conditions should always be suspected

Sacro-iliac disease is a fairly common cause of sciatica, and is frequently overlooked. Injury, either by a direct blow or by stretching of the nerve, may cause the condition

**SYMPTOMS** Pain and tenderness down the course of the nerve (back of thigh and calf). The pain may be most marked at either end of the nerve, e.g. in the foot or near the sacrum. A characteristic sign is pain when the leg is flexed at the hip and extended at the knee. There may be wasting of the thigh and leg muscles in prolonged cases

**SEQUELAE.** Nil

**DURATION** Indefinite. From two weeks to six months. It is very liable to recur

## **SPINAL CORD**

Many of the general diseases of the nervous system are associated with combined degeneration of the brain and spinal cord, but there are one or two important diseases due primarily to abnormalities of the spinal cord

### **1. Concussion of the Cord (Railway Spine).**

**CAUSE.** Some injury such as violent jarring of the spine, not necessarily accompanied by any gross damage

**SYMPTOMS.** Pain in the back and weakness of the limbs. Great tenderness over certain areas of the spine, so that the slightest touch may cause acute pain. General symptoms of neurasthenia, which is always well marked

SEQUELAE Nil

DURATION As in neurasthenia , indefinite

## 2. Syringo-myelia.

A disease characterized by softening of certain areas of the spinal cord round its central canal, and alteration of sensation

CAUSE Unknown

SYMPTOMS Pain in the neck and arms , wasting of muscles of arm , increase of reflexes The most characteristic symptom is the loss of sensation of heat and pain, whereas ordinary touch sensations are not affected

SEQUELAE Nil

DURATION A slow progressive disease, which may last for many years

## Tetany.

A disease characterized by cramp-like contraction of the muscles of hands and feet, sometimes of arms and face

CAUSE It may follow a large number of disorders, e g gastric disorders, especially dilation, rickets, acute infective diseases, removal of the thyroid gland (probably due to the removal at the same time of the parathyroids) It is sometimes caused by occupations, e g in shoemakers

SYMPTOMS Spasmodic contraction of the muscles of the hands and toes, so that the fingers are drawn together into the palm with the end joints extended The toes are pressed closely together, and the wrists and elbows may be bent

SEQUELAE Nil

DURATION Four to six weeks, and may recur, according to the nature of the cause

## Tic (Habit Spasm)

Spasmodic and involuntary movements of the muscles, usually of the neck and face

This form of tic occurs in children and is very common, consisting of spasmodic movements of the muscles of the face or shoulders The children are usually of a nervous type and may be

the subject of some nerve irritation, e g due to adenoids, nasal defect, or carious teeth It is not disabling unless very marked

Other forms of tic, e g Impulsive Tic, occur, but they are uncommon and need not be described

### **Tic Douloureux** (Neuralgia of the fifth cranial nerve).

This name is only given to the severest forms of neuralgia of this nerve (*Trigeminal*)

CAUSE Unknown.

SYMPTOMS Violent and paroxysmal attacks of pain in the side of the face affected The spasms of pain may occur with great frequency and may become insupportable

SEQUELAE Nil

DURATION Indefinite The very severe operation of dividing the roots of the nerve in the skull may be necessary.

## CHAPTER XXVI

### DISEASES OF THE DIGESTIVE SYSTEM

#### **Alveolar Abscess (Gumboil)**

AN abscess beneath the gums

CAUSE Usually carious teeth, or inflammatory conditions of the jaw

SYMPTOMS Painful throbbing and swelling of the gum

SEQUELAE Nil

DURATION Three to four days onwards, according to the cause  
The abscess usually bursts after a few days, and may then clear up altogether, or may recur until the cause (septic tooth or disease of the jaw) is removed It is not as a rule disabling for more than a day or two

#### **Appendicitis.**

Inflammation of the vermiform appendix.

CAUSE Due to infection of the appendix usually from organisms present in the bowel Chronic constipation, by preventing the efficient emptying of the bowel, may allow faecal material to remain in the appendix and cause inflammation

SYMPTOMS *Acute* Pain in the right iliac fossa, rise of temperature and pulse, vomiting; constipation

*Chronic* Pain in the right iliac fossa, constipation, indigestion

SEQUELAE Abscess formation and rupture into peritoneal cavity, causing general peritonitis Pylephlebitis Thrombosis

DURATION *Acute* Ten to twenty-one days After operation, four to six weeks If abscess present disability after operation may last three to four months

*Chronic* Indefinite After operation, four to six weeks

#### **Cancer of Oesophagus.**

CAUSE Unknown

SYMPTOMS Difficulty and pain on swallowing, becoming progressively worse until the patient is unable to swallow even liquids,



wasting, hoarseness of voice if the growth is high up and pain in chest if the growth is low down, are common symptoms

SEQUELAE Nil

DURATION Six to twelve months Operation by passing a tube through the constriction caused by the growth, or making an artificial opening into the stomach through the abdomen (Gastrostomy) may prolong life for a few months

### **Carcinoma of Stomach (Cancer).**

CAUSE Unknown May follow chronic gastric ulcer

SYMPTOMS Persistent pain after food, and a gnawing pain at other times, vomiting The vomit is usually persistent and is frequently brown in colour due to slow bleeding from the growth Serious loss of weight occurs and the patient's skin takes on a yellowish tinge in the later stages, and he suffers from absorption of poison from the growth, which gives rise to general signs of anaemia and profound wasting, a condition known as cachexia

Secondary deposits occur in other parts of the body, especially in the liver

SEQUELAE Nil

DURATION Fatal within six to twelve months. Operation in the early stages may prolong life for two or three years

### **Cholecystitis (Inflammation of the Gall Bladder)**

CAUSES Infection by organisms, probably from the bowel, irritation by gall stones (*q v*).

SYMPTOMS. If due to stones the symptoms are due to them Otherwise symptoms are confined to tenderness in region of the gall bladder, with possibly enlargement of the organ, rise of temperature and pulse

SEQUELAE Local or general peritonitis, multiple abscesses in liver, pyaemia

DURATION Up to eight or ten weeks, unless suppuration occurs, when operation is necessary, and convalescence may be prolonged for three to six months

### **Cirrhosis of the Liver.**

A condition in which the liver tissue is to a greater or less extent converted into fibrous tissue.

**CAUSE** Chronic irritation or inflammation, may be due to syphilis, alcohol, specific fevers (e g malaria), heart disease

**SYMPTOMS** These are due not so much to the cirrhosis, which may exist for a long time without giving rise to any symptoms, as to the primary cause of the cirrhosis. Symptoms which may be present, due to the condition of the liver, are tenderness in the right hypochondrium, dyspepsia, vomiting, irregularity of the bowels; bad complexion, occasionally jaundice

**SEQUELAE** Chronic peritonitis (ascites), heart failure

**DURATION** Indefinite. The condition can only be relieved and not cured

### **Colitis (Inflammation of the Colon (Large Intestine)).**

**CAUSE** Irritation from bacteria or poison

**SYMPTOMS** Pain and tenderness along the course of the large bowel. In acute cases diarrhoea with passage of mucus and sometimes blood per rectum. In chronic cases there may be constipation with intermittent diarrhoea. In severe cases ulcers may develop when the condition is known as *ulcerative colitis*.

**SEQUELAE** Neurasthenia is a common result of the prolonged course the disease takes

**DURATION** Indefinite. Very intractable

### **Dyspepsia (Indigestion)**

This is really only a symptom of some gastric or other abdominal disorder

**CAUSES** These are too numerous to detail, but some of the commonest are gastritis, gastric ulcer; cancer of stomach, appendicitis, atony of the stomach, gall stones; hyperacidity of the gastric juice

**SYMPTOMS** Pain after food, sometimes only after certain types of food, abdominal distension, flatulence; loss of weight

**SEQUELAE** Nil

**DURATION** Indefinite

### **Duodenal Ulcer**

Ulceration of the duodenum, usually of the first part.

**CAUSE** Unknown. Frequently associated with long history of dyspepsia

**SYMPTOMS.** Abdominal pain usually two hours or longer after food, relieved by taking food, feeling of distension, passage of dark blood in stools (Melaena), vomiting

**COMPLICATIONS.** Perforation of the ulcer may occur leading to peritonitis (acute general or local), sub-hepatic abscess, constriction of the duodenum near the pylorus giving rise to symptoms of pyloric stenosis, i.e. obstruction of the pylorus, violent vomiting of large quantities of stomach contents being the chief of these, anaemia

**DURATION** The symptoms come on in attacks which may last a week or two and then subside, but the patient frequently develops a chronic dyspepsia which may necessitate operation. After operation disability may last two to four months.

### **Enteritis (Inflammation of the Intestine)**

Frequently associated with inflammation of the stomach (gastro-enteritis) or colon (entero-colitis)

**CAUSES** (a) Improper food (b) Chemical intestinal irritants, e.g. arsenic, mercury (c) Specific fevers, e.g. dysentery, tubercle, cholera, typhoid fever, pyaemia and septicaemia (*q v*).

**SYMPTOMS.** Diarrhoea, colic, abdominal tenderness, passage of blood and mucus per rectum

**SEQUELAE** Nil

**DURATION** Indefinite. In acute cases, one to three weeks

### **Enteroptosis (Visceroptosis Dropping of the Intestines)**

**CAUSE** Usually due to lack of tone in the abdominal muscles, which normally support the abdominal contents

**SYMPTOMS** Constipation, general lassitude, gastric disturbances, pain in back

**SEQUELAE** Neurasthenia commonly follows

**DURATION** Indefinite. Massage and exercise for the abdominal muscles may diminish the symptoms, and the wearing of an abdominal belt is of assistance. These patients are liable to persistent and chronic ill-health

### **Fissure.**

A crack in the skin and mucous membrane of the anus

**CAUSE** Constipation and haemorrhoids which may be torn and so give rise to the fissure

**SYMPTOMS** Extreme pain when the bowels are open, slight bleeding and discharge

**SEQUELAE** Local abscess formation

**DURATION** Indefinite until operation Incapacity following operation, two to three weeks It is only in exceptional circumstances that a fissure is incapacitating

### **Fistula.**

Any abnormal opening of a hollow viscus through the skin is called a fistula The commonest is an opening from the rectum to the side of the anus, "Fistula in ano" Caused usually by the opening of an abscess into the bowel and externally as well, causing a narrow passage through which slight discharge of pus occurs

**SYMPTOMS** Discharge, local tenderness and constipation

**SEQUELAE** Nil

**DURATION** Indefinite, until operation is performed, when incapacity lasts two to six weeks An ordinary fistula is not in itself incapacitating

### **Gall Stones (Chole-lithiasis).**

Concretions formed by cholesterol and lime salts formed in the gall bladder or liver, and if in the latter usually passed into the bile ducts where they become lodged

**CAUSES** Unknown, frequently follow an inflammation of the gall bladder (chole-cystitis, *qv*).

**SYMPTOMS** Dyspepsia, flatulence, acute pain of a colicky nature, occurring in paroxysms and frequently associated with vomiting (gallstone colic), tenderness in the gall bladder region, clay-coloured stools and jaundice if the common bile duct is blocked

**SEQUELAE** The stones may be passed into the bowel Acute inflammation of the gall bladder with abscess formation and rupture into the peritoneum, giving rise to general peritonitis

**DURATION** Indefinite Recurring attacks may last a week or two at a time, or the patient may be the subject of continuous abdominal discomfort and ill-health until the stones are removed by operation Convalescence after operation, about six to thirteen weeks

**Gastric Ulcer** (Ulceration of the stomach wall)

CAUSE Unknown

SYMPTOMS Dyspepsia, burning pain in the epigastrium, vomiting, haematemesis, melaena (blood in stools), loss of weight

SEQUELAE Perforation of the ulcer may lead to general peritonitis. Cancer of stomach probably follows chronic ulceration in some cases

Scarring of ulcer may lead to obstruction at the pyloric end of the stomach, so that the stomach becomes enormously distended, or if the constriction takes place in the middle of the stomach, it may be divided almost into two (hour-glass stomach)

DURATION Acute attacks may last one to six weeks. In chronic cases the duration is indefinite. Convalescence from operation, four to twelve weeks

**Gastritis** (Inflammation of the stomach)

CAUSES *Acute* (a) Improper food, (b) Poisons, (c) Hyperacidity

*Chronic* (a) Persistent irritation by improper food or food taken in too large quantities, (b) Repeated small doses of poison, e.g. arsenic, lead, alcohol, (c) Anaemia, Bright's disease, gastric ulcer, cancer of stomach, cirrhosis of liver (*q v*).

SYMPTOMS Pain after food, feeling of distension, burning pain in stomach with acid eructations, vomiting, loss of weight, general ill-health, neurasthenia

SEQUELAE Gastric ulcer, neurasthenia

DURATION *Acute* up to two or three weeks *Chronic* Indefinite

**General Peritonitis.**

A generalized inflammation of the lining of the abdominal cavity (Peritoneum)

CAUSES *Acute* Infection is usually conveyed by the rupture of an abscess, e.g. appendicular, bowel or stomach (due to ulceration). An acute infection occurs in tubercle or may be due to the Pneumococcus

*Chronic* Tubercle

**SYMPTOMS** *Acute* (i) Acute pain generalized over the abdomen ; (ii) Rigidity of the abdominal muscles ; (iii) Rise in pulse and temperature followed possibly by (iv) Collapse

*Chronic* Constipation or diarrhoea, abdominal distension, loss of weight and general mal-nutrition

**SEQUELAE** Persistent abdominal pain due to adhesions ; constipation , general debility and ill-health.

**DURATION** *Acute* Fatal within a few days unless operation is performed, when convalescence may last up to three months.

*Chronic* Indefinite

### **Haemorrhoids (Piles)**

**CAUSES** Constipation , growth of the rectum ; overfeeding or drinking

**SYMPTOMS** Constipation , pain on passing motion ; bleeding from the rectum and the presence of a swelling at the anal orifice

**SEQUELAE** Fissure , abscess formation , fistula ; thrombosis of local veins

**DURATION** Indefinite If slight, suitable treatment may relieve the condition in a week or two If marked, the only cure is operation, which may incapacitate the patient for two to three weeks

### **Hernia (Rupture)**

The protrusion through the abdominal wall of part of the abdominal contents (Usually intestine )

**CAUSE** Weakness of the abdominal wall at birth (congenital). Weakness of the abdominal wall caused by strain Weakness of the abdominal wall caused by operation

**VARIETIES** According to the cause the rupture may be congenital or acquired

According to its position it may be inguinal (in the groin), femoral (just below the groin), umbilical (at or near the navel), ventral (through the general musculature of the abdominal wall, frequently through a weak spot caused by an operation scar) Reducible if the swelling can be pushed back into the abdomen ; irreducible if not

**SYMPTOMS** Swelling in region affected, more marked in erect than recumbent position (in this position the swellings frequently

disappear altogether), aching or dragging pain, aggravated by any straining

**COMPLICATIONS** Obstruction of the hernia may take place so that the intestinal contents cannot pass, giving rise to intestinal obstruction

*Strangulation.* If the hernia becomes larger or congested, the intestine may be nipped, so that the blood vessels as well as the intestine are obstructed. The bowel is then said to be strangulated and will die, causing the death of the patient, unless relieved by operation.

**DURATION** Incapacity due to rupture depends on the variety. Reducible ruptures can almost invariably be controlled by a truss, in which case there is no incapacity. Without a truss a simple rupture causes partial incapacity for heavy work only.

An irreducible hernia causes partial incapacity (for heavy work). After operation for ordinary rupture, a patient is fit for light work in six weeks, and heavy work in three months.

In case of strangulation, the incapacity is as for intestinal obstruction (*q v*)

**TRUSSES** The treatment of rupture by trusses is to be recommended only in special cases. No truss ever cured a rupture, and operative treatment in suitable cases is almost invariably successful. Trusses are indicated in the following cases—

1 Where the rupture is easily controlled and there are special reasons for avoiding an anaesthetic, i.e. in cases of chronic bronchitis or serious heart disease

2 As a temporary expedient to enable a working man to resume work while waiting for operation

3 In any patient where the chances of successful operation are slight, owing, perhaps, to weakness of the abdominal wall, excessive adiposity, or other cause

An almost infinite variety have been devised. The so-called "appliances" act on exactly the same principle as an ordinary spring truss, and are much more expensive. There is no doubt that the most efficient truss is the ordinary spring truss. It is, however, sometimes uncomfortable when first worn, even though properly fitted. Such discomfort usually soon wears off. In every case a truss should be fitted accurately, and if necessary, made to

measure If a hernia is not too large and can be easily reduced, there is no reason why a truss should not retain it in position, and enable a man to do any except, perhaps, the very heaviest work. A truss fails, as a rule, not because the strain is excessive, but because the strain is applied with the body in a twisted or awkward position. In such cases it may be impossible to control the hernia effectively.

### Intestinal Obstruction.

A mechanical obstruction of the bowel, whereby the intestinal contents are prevented, wholly or in part (complete or incomplete obstruction) from passing along. It may be acute or chronic.

**CAUSES** Cancer or other growths, adhesions from inflammatory conditions, twisting of the bowel; hernia.

**SYMPTOMS** *Acute* Severe abdominal colic, constipation, progressive vomiting at first of the stomach contents, and later of the bowel contents lower down, rapid and feeble pulse, abdominal distension.

*Chronic*: Attacks of acute abdominal pain, chronic and increasing distension of the abdomen, increasing difficulty in opening the bowels.

**SEQUELAE** Dependent on the cause and the results of treatment. It is sometimes necessary to leave a permanent artificial opening in the bowel (colostomy).

**DURATION** *Acute* Two to four days, when death ensues unless operation is performed. Incapacity following operation depends entirely on the cause of the obstruction. If the cause can be completely removed, incapacity may last four to eight weeks. If not, the incapacity will probably be permanent and the case prove fatal, although by forming an artificial opening above the obstruction (colostomy) life may be prolonged.

*Chronic*. Dependent entirely on cause. Incapacity may be partial only until the symptoms become acute.

### Jaundice.

Yellowness of the skin due to the deposit in it of bile or blood pigments.

**CAUSE** Any cause of obstruction of the bile ducts or of the



small ducts within the liver may give rise to jaundice, e.g. catarrhal inflammation of the liver and its ducts, gall stones, cancer of the liver or head of the pancreas causing pressure on the common bile duct, syphilis. On the other hand, it may be due to abnormal breaking down of red blood corpuscles, by which the blood pigments are liberated and tinge the skin as in some of the anaemias.

**SYMPTOMS** Those due to jaundice itself are, (i) yellowness of the skin, and sclerotic of the eye, (ii) itching of the skin; (iii) a tendency to bleed more freely than normal. Other symptoms are due to the primary cause.

**SEQUELAE** Dependent on the cause.

**DURATION** Depends entirely on the cause. In ordinary catarrhal jaundice the duration is from one to five or six weeks.

### **Liver Abscess.**

**CAUSE** If single the usual cause is amoebic dysentery. It may follow direct injury to the liver. If multiple, the commonest cause is pyaemia, of which it is a very dangerous complication.

**SYMPTOMS** High temperature, enlargement of liver, and a general septic infection are the common symptoms.

**COMPLICATIONS** The abscess may rupture into the lung, or into the peritoneal cavity, giving rise in the latter case to a general peritonitis.

**DURATION** Indefinite. The multiple form due to pyaemia is usually fatal within a week or two. The solitary abscess may persist for years.

### **Pancreatitis (Inflammation of the Pancreas)**

This is a relatively uncommon disease, and very difficult to diagnose.

**CAUSE** Unknown, possibly infection from the bowel.

**SYMPTOMS.** The condition may be acute or chronic.

In the acute form the patient is taken suddenly ill with a high temperature and the symptoms of an "acute abdomen," e.g. acute abdominal pain and tenderness, vomiting, and collapse.

In the chronic form the symptoms are gastric in nature, but are not well defined, and unless there is a definite tumour present, they are not usually sufficiently clear to make a diagnosis possible.

**SEQUELAE** Chronic indigestion and abdominal pains

**DURATION.** The acute form is usually operated on before a diagnosis is made, and if recovery takes place convalescence may take six to thirteen weeks. It is frequently fatal within one to two weeks.

### **Perityphlitis** (Inflammation of the Caecum)

The cause, symptoms and duration are as for appendicitis (*q v*)

### **Pharyngitis** (Inflammation of the pharynx)

**CAUSES** Cold and exposure, infection with septic organisms, irritation from drinking and smoking to excess

#### (i) *Acute*

**SYMPTOMS** Soreness on swallowing, dryness of throat with cough, enlargement of glands in the neck, increase in temperature

**SEQUELAE** Nil

**DURATION** One to three weeks

#### (ii) *Chronic*

**SYMPTOMS** Dryness and irritation of the throat; cough due to constant irritation from excessive secretion of mucus

**DURATION** Indefinite. Not disabling except in those who need to use their voice constantly

### **Quinsy** (Abscess round the tonsil)

**CAUSE** As for acute tonsillitis. The infection usually spreads from the tonsil to the surrounding tissues, and an abscess forms, which is known as a quinsy. This abscess lies usually above or behind the tonsil.

**SYMPTOMS** As in acute tonsillitis, but much more marked

**SEQUELAE** Nil

**DURATION** One to three weeks, or more if the patient's general condition is poor

## **RECTUM.**

### **Cancer.**

**CAUSE** Unknown

**SYMPTOMS** Constipation, bleeding from the rectum, passage of mucus, intestinal obstruction (*q v*), wasting, pain in pelvis

**COMPLICATIONS** The growth may invade surrounding structures, e g prostate and bladder, and give rise to urinary symptoms

**DURATION** Fatal within six to eighteen months unless removed In early stages it is possible to effect a cure, but, as a rule, the growth is so advanced when advice is sought, that the fatal issue may only be postponed for three or four years

It is sometimes possible to remove the growth and re-establish the continuity of the bowel, but more often a colostomy has to be performed This operation may have to be performed merely to relieve symptoms of obstruction, even if the growth cannot be removed Incapacity for heavy work is permanent after this operation

### **Prolapse.**

A protrusion of the lower part of the rectum, usually periodic and following defaecation

**CAUSE** May be due to haemorrhoids

**SYMPTOMS** Presence of swelling projecting from the anal orifice which can be temporarily returned within the anal canal, pain and discomfort, some bleeding may occur or the mucous membrane may become ulcerated

**DURATION.** The condition is intractable to treatment in many cases, and disabling owing to the pain and discomfort Operation in many cases is the only satisfactory treatment Disability following this is from three to six weeks

### **Stomatitis (Inflammation of the mouth)**

**CAUSES** Infection of the mucous membrane by organisms, frequently from carious teeth or from infected tonsils

The commonest form of mild stomatitis is that characterized by minute ulcers of the mucous membrane (so called Peptic ulcers), which are usually associated with dyspepsia Other forms are—

*Aphthous stomatitis*, characterized by a crop of small ulcers appearing during dentition in children

*Gangrenous stomatitis*, occurring in debilitated children in which extensive destruction of the mucous membrane of the mouth occurs

*Ulcerative stomatitis.* Similar to the preceding, but not so severe, commonest in children

*Thrush* An infection of the throat and mouth due to a fungus called the *Oidium Albicans* Common in children, but sometimes occurs in adults.

*Mercurial stomatitis*, due to poisoning by mercury Characterized by swollen, painful, and bleeding gums and excessive salivation

GENERAL SYMPTOMS of all the above, but varying in degree, are, soreness of the mouth, pain on mastication, excessive salivation, general malnutrition, unpleasant or even foul odour of the breath.

SEQUELAE Nil, except in severe cases when the teeth may become loose and have to be removed

DURATION One to twelve weeks, according to the severity and cause of the disease

### Tongue, Inflammation and Ulceration of (Glossitis)

CAUSES Similar to those of stomatitis, of which it may be a part

#### SPECIAL FORMS—

*Chronic Superficial Glossitis*, due to irritation of the tongue from excessive smoking, drinking, or to syphilis

#### *Ulcers of the tongue—*

(i) *Dental* Occurring at the margins of the tongue, and due to irritation from decayed and jagged teeth

(ii) *Tuberculous* Usually associated with tubercle elsewhere in the body These usually occur in front of the tongue

(iii) *Syphilitic* May be superficial or deep, and occur in any part of the tongue.

(iv) *Malignant* (Cancerous) Occur usually in elderly people May follow chronic dental ulcers, usually occur at the sides of the tongue

SYMPTOMS Pain on mastication and swallowing, general malnutrition and ill-health, enlargement of glands in neck, and in malignant cases fixation of the tongue, so that it cannot be protruded

SEQUELAE. Nil.

DURATION. As for Stomatitis, but most of the ulcerations of the tongue are very intractable. Malignant disease is incurable

except by operation, and the convalescence after the operation varies from six to twelve weeks, and the chances of recurrence are very great

**Tonsillitis** (Inflammation of the tonsils Follicular Tonsillitis).

CAUSE. Infection of the tonsils by septic organism

(1) *Acute*

SYMPTOMS. Painful enlargement of tonsils with high temperature and pain on swallowing

COMPLICATIONS Enlargement of glands of the neck, and abscess formation, septicaemia; quinsy (*qv*)

DURATION One to two weeks

(ii) *Chronic*

SYMPTOMS Tonsils may be larger or smaller than usual, recurrent attacks of acute tonsillitis occur, and the patient suffers from general ill-health, owing to persistent absorption of poisons from the tonsils

COMPLICATIONS Chronic enlargement of the cervical lymphatic glands, frequently associated with adenoids and deafness Rheumatic pain in muscles and joints may occur, neuritis, dyspepsia

DURATION Until the tonsils are removed, after which the patient should recover in two to three weeks

## CHAPTER XXVII

### UNCLASSIFIED DISEASES

#### **Addison's Disease** (Disease of the Suprarenal Glands)

**CAUSE** Tubercle or other infection

**SYMPTOMS** Anaemia, feeble heart action, general weakness, pigmentation of the skin

**SEQUELAE** Nil

**DURATION** Indefinite Usually fatal in three to twenty-four months

#### **Adenitis** (Inflammation of lymphatic glands)

This may be acute or chronic

##### *Acute*

**CAUSE** As the glands receive lymphatic fluid from all parts of the body, any small septic focus in the skin or other tissues may be the cause of infection reaching the glands This is by far the commonest, if not the only, cause The glands first affected are those in the neighbourhood of the source of infection

**SYMPTOMS** Pain and swelling of the glands, increase in temperature

**DURATION** Indefinite, depending on the disappearance of the primary source of infection

If the acute condition lasts more than seven or ten days, an abscess or abscesses are almost sure to be formed

**SEQUELAE** Abscess formation; septicaemia, pyaemia, etc

*Chronic* This form is very common, especially in children

**CAUSE** It is probably always due to a mild infection from some external cause, e.g. throat infection, absorption of poison from the bowel The commonest position of the affected glands is the neck, and the tonsils, teeth, scalp, and skin of the face are the commonest sources of the infection In some cases, where no primary cause can be found, the infection may be due to tubercle carried in the blood stream.

**SYMPTOMS** Enlargement of the glands accompanied by general ill-health. So-called "Cold abscesses" may form, i.e. the gland may

break down slowly and pus form without the signs of acute inflammation

**DURATION** Indefinite The cause must be dealt with and the general health maintained, and in favourable cases the glands may disappear in the course of two or three months

Usually the condition lasts for many months and may necessitate removal of the glands Disability following the operation is three to four weeks, but a prolonged convalescence, lasting over several months, is usually necessary to restore the full health.

## BREAST.

Diseases of the female breast are commonly due either to inflammatory changes or to new growths (tumours)

### Tumours.

These may be either innocent or malignant, and the symptoms, duration, and sequelae of these are similar to those of growths elsewhere in the body, with, of course, modifications due to the position of the growth The reader is, therefore, referred to the remarks on Tumours It might be added here that complete removal of the breast by itself is accompanied by no disability after recovery from the immediate effects of the operation (four to five weeks) except, of course, that if the woman become pregnant one breast only will be available for feeding the infant

If, however, as is the case with all forms of cancer that may occur in the breast, it is necessary to remove part or all of the underlying muscles and the glands in the axilla, limitation of movement and weakness of the shoulder will result, causing permanent partial disability

The commonest forms of growth found in the breast are adenoma, cysts, and carcinoma

### Mastitis (Inflammation of the breast)

This may be acute or chronic

**CAUSE** 1 *Acute* Usually due to excessive activity with cracking of the nipples while suckling It may develop apparently spontaneously, or as a result of a blow

2 *Chronic* The breast is peculiarly liable to develop a chronic

inflammatory condition as age advances, and with no apparent cause, although irritation by corsets may be an exciting factor

**SYMPTOMS** *Acute* As for acute inflammation and abscess in any part of the body

*Chronic* Very few symptoms are caused A little dragging or aching in the breast, accompanied by a knobbly feeling to the touch, may be present

**SEQUELAE** *Acute* Abscess formation, pyaemia, septicaemia, etc

*Chronic* May develop into a carcinoma

**DURATION** *Acute* Three to four weeks

*Chronic* It is not disabling The condition persists indefinitely

#### EFFECTS OF INJURY ON THE BREAST

*Bruising* Simple bruising causes no symptoms likely to be disabling, but it may be followed by abscess formation (See "Breast—*Acute* Mastitis")

**WOUNDS** These follow the same course as wounds elsewhere in the body

It is frequently alleged that a growth of the breast may follow a blow and be caused by it This has been successfully claimed in a court of law, but there is no definite evidence that a cancer is so produced In most cases there is a history of previous swelling, and in any case, as far as medical knowledge is concerned, the only argument available in favour of it is that of "Post hoc erga propter hoc," which is, of course, no argument The rate of growth of a tumour may, however, be accelerated by a blow

#### Bursitis.

Inflammation and enlargement of the bursae (small fluid-containing spaces covering bony points)

**CAUSE** *Acute* Infection by direct injury In other cases the bursae may become suddenly enlarged in many parts of the body, this being sometimes associated with rheumatic conditions Specific causes may be tubercle, syphilis, and gonorrhoea

*Chronic* May follow the acute form other than that due to direct injury. The multiple form may become chronic The commonest cause is constant irritation by occupations, e.g. enlargement



of the prepatellar bursae by constant kneeling (housemaid's knee), and enlargement of the olecranon (elbow) bursa due to pressure from working in mines or in other occupations where pressure on the elbows occurs

**SYMPTOMS** In acute infective bursitis the symptoms are those of abscess elsewhere in the body. In other forms the symptoms are of little importance, but the projecting swelling is liable to be knocked and injured, perhaps causing suppuration. The bursae also tend to become tender and pressure over them causes pain.

**COMPLICATIONS** In some cases the bursae may communicate with the neighbouring joint, and an arthritis may result.

**DURATION** *Acute* Ten to twenty-eight days *Chronic* Indefinite

### Carbuncle.

A local inflammation of the subcutaneous tissues which may slough in a mass and leave a large discharging surface. Particularly common on the neck and back.

**CAUSE** Infection by septic organism, usually through the skin, sometimes conveyed by the blood.

**SYMPTOMS** Pain and tenderness and redness of the affected area, general symptoms of debility. If the carbuncle discharges there may be several points on the area from which discharge comes.

**SEQUELAE** Nil

**DURATION** In slight cases the inflammation may subside in a few days; in bad cases large areas of skin may slough and the raw surface so caused may take months to heal.

### Cyst.

A cyst is an abnormal fluid-containing swelling. Its contents may be blood, secretion of a gland, e.g. sebaceous cyst or mammary cyst, or clear mucus.

These may occur in almost any part of the body, and may attain enormous size.

The commonest cyst is the *Sebaceous Cyst*, which is caused by the mouth of one of the sebaceous glands of the skin becoming blocked and the secretion accumulating behind it. These cysts may occur on any part of the skin except the palms of the hands.

and the soles of the feet They are commonest on the head, neck, and back

When occurring on the head or neck they are frequently popularly called "Wens"

**SYMPTOMS** These cysts give rise to no symptoms apart from the local ones of irritation from the pressure of clothing, unless they become inflamed, when abscess formation results and the symptoms are those of an ordinary abscess *Injury* may be a cause of inflammation

**DURATION** Indefinite They cause no disability unless they become inflamed Incapacity following operation lasts from one to seven days In many cases they can be removed under a local anaesthetic and the patient return to work immediately

**COMPLICATIONS** Abscess formation due to infection by septic organisms

### *Ovarian Cyst*

This is a cyst formed in the ovary and may attain an immense size, containing a gallon or more fluid.

**SYMPTOMS** It gives rise to no symptoms in the early stages, but as it increases in size symptoms resulting from pressure on the organs in the pelvis occur, pain of a dragging nature; irritation of the bladder, constipation from pressure on the bowel, and general discomfort as the tumour becomes large In the later stages the abdomen becomes protuberant and it sometimes leads the patient to imagine she is pregnant Menstrual irregularity is common

**DURATION** Indefinite, unless removed by operation. After operation, three to twelve weeks

**COMPLICATIONS** These cysts may become twisted, giving rise to sudden acute pain and collapse of the patient, necessitating immediate operation They may become malignant (cancerous)

### *Cyst of the Epididymis.*

Small cysts may develop in the epididymis in the male and give rise to no symptoms except a little dragging pain They rarely cause any disability They may follow injury and are frequently mistaken for hydrocele

*Cyst of the Cord*

A cyst may develop anywhere along the line of the spermatic cord. It lies outside the cord, frequently near the inguinal ring, and may be mistaken for a hernia. It is not caused by injury, but may be aggravated by a direct blow. It rarely causes any disability.

Cysts may develop in many other parts of the body, but it is impossible in a work of this kind to enumerate them all. The above are the commonest.

**Diabetes.**

A wasting disease characterized by deficiency in absorption of sugar, which is passed in the urine (Glycosuria)

There are two varieties—

1 Diabetes Mellitus

2 Diabetes Insipidus

1 *Diabetes Mellitus*

CAUSE Unknown. Frequently associated with some deficiency in the pancreatic secretion (internal)

SYMPTOMS Frequency of micturition, with the passage of an excessive amount of urine; thirst, loss of weight, urine of high specific gravity. The patient may become comatose.

COMPLICATIONS Boils and eczema and ulceration, or even gangrene of the skin, neuritis, retinitis, iritis.

DURATION Indefinite

2 *Diabetes Insipidus*

CAUSE Unknown

SYMPTOMS Passage of large quantities of urine, thirst, small amount of sugar may be passed.

COMPLICATIONS Nil.

DURATION Indefinite. It is not disabling except from the necessity for frequent micturition.

**Glycosuria (Literally, Sugar in Urine)**

This is a symptom of diabetes, but it may exist without the excessive wasting and serious complications of true diabetes. The amount of sugar excreted in these cases can be readily controlled by diet and the condition is therefore amenable to treatment. Such cases are sometimes termed Alimentary Glycosuria.

**GLYCOSURIA FOLLOWING INJURIES** Injuries accompanied by severe shock are sometimes followed by glycosuria, which usually passes off. In some cases, however, particularly if the symptom has been present before the accident, the condition may be aggravated and incapacity prolonged indefinitely.

**COMPLICATIONS** Uncommon

**DURATION** Indefinite

### **Fibrositis** (Literally, an Inflammation of Fibrous Tissues)

**CAUSE** May follow injury, or febrile conditions, such as influenza, septicaemia, toxæmia, or infection due to other organisms, e.g. gonorrhoea.

**SYMPTOMS** Identical with those of muscular rheumatism, but the site of the pain is at the origin of the muscles from the bone, or in the fibrous sheaths of the muscles.

**COMPLICATIONS** Nil

**DURATION** Three to six weeks

### **Frostbite.**

A local anaemia of the tissues due to excessive cold.

**CAUSES** Excessive cold, particularly if associated with moisture.

**SYMPTOMS** The parts affected are first blanched and numbed, but when the cold is removed a reaction occurs, and the skin becomes reddened and may be acutely painful.

If the cold has been acting for any length of time, or has been particularly severe, damage may be caused to the cells of the blood vessels and surrounding tissues. This may result in death of the parts and gangrene.

**SEQUELAE** Local gangrene which, if extensive, may lead to loss of part or the whole of a limb, or even death.

**DURATION** Indefinite, depending on the severity.

### **Ganglion.**

A protrusion of the synovial membrane of tendon sheaths or joints.

**CAUSE** May be caused by disease, e.g. tubercle or other forms of arthritis.

May be caused by gradual or sudden straining of a joint or tendon

**SYMPTOMS.** Weakness of the affected part and pain on putting the joint or tendon into action.

**DURATION** Symptoms will persist until the ganglion disappears. Absolute rest and local applications may effect this in the case of small ganglia, but many weeks are necessary. In other cases operation is the only means of relief, and in all cases recurrence is extremely likely

### **Gangrene** (Mortification and death of the tissues)

**CAUSES** Acute septic infections, affection of the blood or blood-vessels causing bad nutrition (e.g. in diabetes, frostbite, and artero-sclerosis, where the blood-vessels are thickened and so the blood supply is diminished, this form is known as *Senile Gangrene*).

**SYMPTOMS** There are two forms, moist and dry gangrene. The former is usually associated with septic infections where the tissues become swollen and reddened and finally slough and die. The symptoms are chiefly those of inflammation. The parts become painless in the last stages.

In the dry form the parts first appear pale and then small particles of blackened skin appear, which gradually extend. Apart from loss of sensation in the part and in the early stages some irritation, the condition is symptomless. When extensive gangrene occurs, the patient suffers constitutionally from the absorption of poisons from the dead tissues.

**SEQUELAE** Nil

**DURATION** Indefinite. Amputation is the only cure in severe cases.

### **Goitre** (Enlargement of the Thyroid Gland)

**CAUSE.** Unknown. Enlargement may be innocent or due to cancer. It may occur in girls at the age of puberty, and has then no special significance as the enlargement gradually decreases.

**SYMPTOMS** These are chiefly due to the mechanical interference with breathing and swallowing caused by the pressure of the tumour on the trachea and oesophagus. Surgical removal is the only treatment likely to effect a cure.

SEQUELAE Chest trouble, e g. chronic bronchitis and tracheitis, not uncommonly follows

INCAPACITY Indefinite After operation, four to eight weeks.

### Graves' Disease (Exophthalmic Goitre).

A disease characterized by enlargement of the thyroid gland, and protrusion of the eyeballs

CAUSE Unknown ; but sudden shock or fright may precipitate an attack

SYMPTOMS Enlargement of the thyroid gland ; rapid pulse ; general weakness , flushing ; tremor (due to Hyperthyroidism).

DURATION Indefinite, six to twelve months, with liability to recurrence

COMPLICATIONS Myxoedema (*q v*)

### Haemophilia.

A disease of the blood, characterized by a tendency to excessive bleeding from a slight injury.

CAUSE Unknown, but it occurs in males only, and is hereditary, the disease being transmitted from the sufferer to the sons of his daughters, but not to his sons or to their children.

SYMPTOMS Diminished clotting power of the blood, causing continuous haemorrhage from slight injury.

SEQUELAE Nil

DURATION Indefinite The haemorrhage from a trivial wound, e g due to the removal of a tooth, may prove sufficient to cause death

### Hodgkin's Disease.

A constitutional disease associated with anaemia and enlargement of lymphatic glands

SYMPTOMS Anaemia ; enlargement of lymphatic glands and spleen

SEQUELAE Nil

DURATION Indefinite Frequently fatal after many months or even years

This disease is sometimes called Generalized Lymphadenoma.

### Lumbago.

A form of muscular rheumatism affecting the muscles of the loins

CAUSE Unknown, probably constitutional and frequently brought on by exposure to cold

SYMPTOMS Pain in the loins and lower part of the back on stooping and rising, tenderness on pressure over the affected muscles

COMPLICATIONS Nil

DURATION One to six weeks

One of the most important problems a medical examiner has to decide is whether the pain complained of is due to lumbago or a strain of the back. The difficulty is increased by the frequency with which an attack of lumbago starts while a man is doing heavy work. The examiner has to rely chiefly on the past history of the patient, and on the immediate history of the attack. A disproportion between the amount of pain and the degree of the alleged strain is one of the most important guides.

### Myxoedema.

A disease due to deficiency in the internal secretion of the thyroid gland

SYMPTOMS If occurring in childhood defective development results and mental deficiency (Cretinism). If occurring in adults the symptoms are increase in weight due to waxy thickening of the skin, coarsening of the features, mental inertia

SEQUELAE Nil

DURATION Ten to fifteen years. Administration of thyroid extract often effects a rapid cure, but has to be continued indefinitely

### Pleurodynia (Pain in the Pleura)

CAUSE The underlying cause may be injury, e.g. bruising of the ribs and costal nerves, pleurisy, neuralgia, rheumatism, spinal disease

SYMPTOMS This is not a disease but a symptom. It is, however, frequently the only symptom, and its cause is often not apparent. For this reason a doctor will sometimes give a certificate of pleurodynia, not knowing the underlying cause. The word means pain in the pleura, and the pain complained of by the patient is usually

of a sharp character, deep in the chest wall, usually worse on deep breathing and sometimes aggravated by muscular work

COMPLICATIONS AND SEQUELAE Nil

DURATION Dependent on the cause. After injury and in rheumatic conditions it may persist for many weeks (six to eight), and is generally disabling

### **Ptomaine Poisoning.**

A name generally given to any form of food poisoning, but originally intended to describe poisoning by alkaloid products of food decomposition

CAUSE Poisoning by food may be divided roughly under three headings—

1 Poisoning by the normal product of a plant or animal, particularly fishes The poisonous mushroom is a common example of this Such "foods" cannot, strictly speaking, be so called, but there are many such members of the vegetable and animal kingdoms which are frequently eaten accidentally

2 Poisoning by food contaminated from outside sources A common example of this is the oyster, which may be contaminated from the muddy bed on which it grows

3 Poisoning by food which has partially decomposed This is true ptomaine poisoning

SYMPTOMS The symptoms arising from (1) and (2) are very variable, as they are dependent on the exact nature of the article swallowed, or of the contamination

An urticarial rash is a common symptom, associated with gastrointestinal irritation, and collapse of the patient after an initial rise of temperature Specific diseases, such as typhoid, may be conveyed in cases coming under the second group above-mentioned

True ptomaine poisoning (group 3) is usually caused by the eating of decomposing meat, e g pork, veal, or beef, and it is not necessary for decomposition to have gone so far as to cause any appreciable abnormality of smell or taste

The symptoms usually start within thirty-six hours of the taking of the food, and may be preceded by a feeling of general ill-health, loss of appetite, etc The main symptoms are shivering, sweating, and general weakness, followed by abdominal pain, vomiting and



diarrhoea The temperature is raised after the first day or two. Fatal cases from exhaustion are sometimes reported

COMPLICATIONS AND SEQUELAE Nil

DURATION One to three weeks in the acute stage. Convalescence may be prolonged for several weeks owing to the exhaustion of the patient

### Rickets.

A disease of nutrition characterized essentially by lack of bony density and hardness and general malnutrition in children

CAUSE. Unknown Probably lack of fresh air, good food and sunlight are predisposing causes

SYMPTOMS These may be general or local

*General* Poor general development, liability to constant catarrh of the mucous membranes, gastro-intestinal disturbances, general flabbiness of the tissues

*Local* These are chiefly of the skeleton The ends of the long bones, near the joints, may be thickened and swollen and tender (so-called growing pains), the bones bend and become deformed, the ribs may become deformed and the chest wall consequently flattened, causing projection of the breastbone (Pigeon-breast) The spine is liable to develop curves, lateral and antero-posterior (See *Scoliosis*, *Lordosis*, and *Kyphosis*)

The only common affections caused by rickets in adults are the deformities of the skeleton caused by the disease in childhood

COMPLICATIONS Susceptibility to catarrhal infection may lead to chronic ear trouble, the mal-development of the chest to chronic cough, tubercle, and bronchitis.

DURATION. If marked deformities (*qv*) of bones are present, these are permanent unless operated upon. Disability from this may last three to six months

The general symptoms will improve with proper treatment, but the condition may take months or even years to cure

### Status Lymphaticus.

A condition of general enlargement of the lymphatic glands, spleen, and thymus glands It occurs most commonly in children and young adults

**CAUSE** Unknown

**SYMPTOMS** No particular symptoms are associated with the condition except in the cases where the thymus is very much enlarged, when there may be shortness of breath. The patients are pale and have an unhealthy appearance, and are, generally speaking, "flabby."

**COMPLICATIONS AND SEQUELAE** The only important sequelae of the disease is sudden death, which may occur owing to cardiac failure in cases to whom an anaesthetic is being administered. The disease is found in a large number of cases of otherwise inexplicable death during anaesthetic administration. The cause is generally attributed to embarrassment of the heart due to the large thymus gland.

**DURATION** Indefinite

### **Sun Stroke (Heat Stroke)**

**CAUSE** Exposure to intense heat, either from direct rays of the sun or to artificial heat from furnaces, etc.

**SYMPTOMS** Unconsciousness and death may supervene almost instantaneously.

In less sudden cases increase in pulse, unconsciousness, high temperature, laboured breathing.

**SEQUELAE** Loss of memory and of mental ability may follow.

**DURATION** May be fatal within twenty-four to forty-eight hours, or symptoms may last a week or two, followed by recovery.

### **Torticollis (Wry-neck)**

This is a condition in which the head is obliquely twisted to one side, the back of the head being pulled downwards and forwards. It is of two varieties, one of which is spasmodic.

**CAUSES** The ordinary non-spasmodic wry-neck may be congenital, or appear soon after birth. It is due to contraction of one sterno-mastoid muscle, either owing to mal-formation of the muscle or to injury at birth followed by scarring of the muscle. It may be caused by inflammatory conditions, causing scarring and so shortening of the muscle. It is not uncommonly due to exposure to cold (stiff neck).

The spasmodic, or nervous type, may be caused by irritation from inflamed glands, carious teeth, or other local cause of irritation

**SYMPTOMS** Inability to straighten the head and neck, and pain on attempting to do so

**SEQUELA** Nil, except in children when, if the deformity is allowed to persist, the face may develop asymmetrically

**DURATION** Dependent entirely on the cause Operative treatment is the only cure in long-standing non-spasmodic types, and incapacity following this may last for some months The ordinary rheumatic form of stiff neck lasts only a few days

## Tumours.

**DEFINITION** Any swelling may be and frequently is called a tumour, but, strictly speaking, a tumour may be defined as a local overgrowth of tissue, which may or may not be found normally at the site of the tumour

**VARIETIES** As are the varieties of the tissues found in the body, so are the varieties of tumour, for there is no tissue which may not give rise to a local overgrowth, and so form a tumour. Tumours are, therefore, named according to the tissue of which they are formed All these names end in the affix "oma," and some of the commonest are—

1	<i>Adenoma</i>	Tumour consisting of gland tissue.
2	<i>Chondroma</i>	„ „ of cartilaginous tissue
3	<i>Fibroma</i>	„ „ of fibrous tissue
4	<i>Haematoma</i>	„ „ of blood.
5	<i>Lipoma</i> .	„ „ of fatty tissue
6	<i>Myoma</i> .	„ „ of muscular tissue
7	<i>Neuroma</i> .	„ „ of nerve tissue
8	<i>Osteoma</i> .	„ „ of bony tissue
9	<i>Papilloma</i> .	„ „ of epithelial tissue
10	<i>Carcinoma</i>	„ „ of cancer cells from glands
11.	<i>Epithelioma</i>	„ „ of cancerous epithelial tissue.
12	<i>Sarcoma</i>	„ „ of cancer cells from connective tissue
13	<i>Ghoma</i> .	„ „ of connective tissue of the brain or spinal cord

14 *Polyypus* . A term applied to any tumour attached by a stalk to the tissue from which it arises

Of the above, Nos 1-9 are always innocent, whereas Nos 10-12 are always malignant Nos 13 and 14 may be either innocent or malignant

#### *Innocent and Malignant Tumours*

The differences between Innocent and Malignant growths and tumours are as follows—

INNOCENT	MALIGNANT
Slow growth	Rapid growth
Cause symptoms by local pressure and displacement of parts	Cause symptoms as innocent tumours, but in addition, destroy the local tissues by actual invasion of the cells
Spread locally only, by increase in size	Spread by the cells invading lymph or blood vessels, and being carried to distant parts where they start growing again as "secondary deposits"
Do not cause death unless by accident of position, e g by pressure on the brain, heart, etc	Invariably cause death if allowed to grow, owing to secondary deposits and absorption of toxins from these, and the primary growth May cause death by invading vital organs

#### **Ulcers.**

An ulcer is an open, septic or granulating, wound of the skin or mucous membrane It is chronic in character, and does not, as a rule, extend deeply

#### **VARIETIES—**

1 *Malignant* A cancer of the skin or near the skin, may destroy this and cause the development of an ulcer

A malignant ulcer is characterized by hard raised edges and a base that bleeds easily It is incurable except by operation (See *Growths* )

2 *Perforating Ulcer*. This is the name given to a very slow or "indolent" form of ulcer usually appearing on the feet or other parts exposed to pressure. It occurs only in patients who are suffering from some constitutional disturbance of nutrition or circulation, e.g. in diabetes, nervous diseases such as tabes dorsalis, arterio-sclerosis. The condition is very intractable. The patient is usually disabled on account of the associated constitutional disease. A trivial injury may cause such an ulcer in the right type of patient, or it may arise spontaneously. Bed-sores are of this type of ulceration.

3 *Varicose* Ulceration of the skin, usually of the shin in patients who suffer from varicose veins. The cause may be a trivial injury which does not heal owing to the poor nutrition of the part.

**SYMPTOMS** Burning and shooting pain in the leg, swelling of the ankles due to a combination of the varicose veins and chronic inflammation caused by the ulcer.

**DURATION.** Indefinite. Absolute rest is essential, but it may take weeks or months to effect a cure.

**SEQUELAE** Thrombosis of the veins and possibly embolism.

For an account of ulcers due to Syphilis and Tubercle, the reader is referred to those headings.

### *Rodent Ulcer*

A peculiar form of slowly spreading ulceration affecting usually the face. It gradually extends until great destruction and disfigurement is caused. The cause is unknown, but it is a type of malignant ulcer.

**DURATION** Indefinite. X-ray treatment is frequently successful in curing this condition, but it is often ultimately fatal after months of suffering.

### **Varicose Veins.**

An abnormality of the veins, whereby they are enlarged and tortuous.

**CAUSE** Developmental or hereditary. May be due to pressure from a tumour or other cause.

**SYMPTOMS** Swelling of the veins of the legs (chiefly), aching and heaviness of the limbs; cramp; swelling of ankles.

## COMPLICATIONS—

1 *Haemorrhage* This may be very profuse if one of the veins is ruptured, as the valves of the veins are incompetent, and the venous system may be almost drained of blood in consequence

2 *Eczema* The skin of the legs below the knee tends to become inflamed from slight irritation owing to the defective circulation

3 *Ulceration* The inflammation of the skin may continue until a raw wound is caused, forming an ulcer which may take months to heal, owing to defective circulation Slight injury to the skin without a pre-existing eczema may cause extensive ulceration

4 *Thrombosis* (Clotting of the blood in the veins) This is usually the result of inflammation of the skin or other neighbouring tissues, and the veins become hardened and tender

5 *Embolism* If one of the clots formed by thrombosis becomes detached, it passes to the heart, and then to the arteries, one of which it blocks, causing symptoms if the vessel is an important one (See *Cerebral Embolism*)

**DURATION** Varicose veins, unless extremely severe, are not disabling, and any disability can usually be prevented by wearing bandages Operation causes disablement for two to three weeks The complications may be serious, especially ulceration, which may cause disability extending over many months

## CHAPTER XXVIII

### DISEASES OF THE EYE

#### Cataract.

A HARDENING of the lens with associated opacity.

CAUSES Direct injury may give rise to a local or general opacity Old age—the so-called *Senile Cataract* It may be congenital

SYMPTOMS Gradually failing vision The lens appears white and opaque when viewed in a strong light

COMPLICATIONS AND SEQUELAE Nil.

DURATION. Permanent The only effective treatment is the removal of the lens, after which glasses must be worn Sufficient sight may so be restored to enable patients to get about safely

#### Choroiditis (Inflammation of the Choroid)

CAUSES. Extreme shortsight, syphilis, injury, inflammation spreading from neighbouring parts, e g iris

SYMPTOMS 1 *Chronic*. Diminution in vision, appearance of spots in front of the eye

2 *Acute*. As for iritis

COMPLICATIONS AND SEQUELAE Nil

DURATION. Indefinite

#### Conjunctivitis (Inflammation of the Conjunctiva)

CAUSES Irritation from foreign bodies, e g dust, etc May be caused by infection by special organisms, e g gonococcus, diphtheria, tubercle

SYMPTOMS Irritation of eye, watering (lacrymation), sensitiveness to light (photophobia); eye is "bloodshot"

COMPLICATIONS Spread of infection to the remainder of the eye, giving rise to iritis, keratitis (inflammation of the cornea), or pan-ophthalmitis (inflammation of the whole eye)

DURATION. Very variable, from two days to six months or more

Simple conjunctivitis due to foreign body usually passes off, except in very severe cases, in two to three weeks

### Detachment of Retina.

Part or the whole of the retina is detached from the underlying choroid coat

**CAUSES** Haemorrhage from high blood pressure or from injury, which may be indirect, i.e. a blow on the head may give rise to a detachment

**SYMPTOMS** Loss of the part of the field of vision corresponding to the site of the detachment

**COMPLICATIONS** A partial detachment may become total, blindness

**DURATION** Permanent

### Errors of Refraction.

Most of the ordinary defective vision is caused by errors of refraction. By such errors is meant that the refracting power of the cornea and lens (see *Anatomy of Eye*) is not able to produce a clear image on the retina

The following are the common errors of refraction—

1 *Myopia* (Short-sight) In this the image of distant objects is formed by the lens of the eye so that it falls a varying distance in front of the retina. To correct it a concave lens has to be worn in front of the eye

2 *Hypermetropia* (Long-sight) In this form the image formed by the lens of near objects lies behind the retina and can be made to fall on the retina only by wearing a convex lens in front of the eye

3 *Presbyopia* (Long-sight) In this form the lens loses its elasticity and cannot therefore adapt itself sufficiently to form an image on the retina, the image of near objects, as in hypermetropia, falling behind the retina. It is so called because it is due to old age. The symptoms can be remedied by wearing a convex lens

4 *Astigmatism* If the surface of the cornea or lens is not a segment of a true sphere, and the curvature in one direction is greater than in another, it is impossible for a clear image to be formed. Such a defect is extremely common, and is remedied by



wearing a glass curved only in one direction, the axis of the curve being so placed as to assist the lesser curve of the cornea in refracting the light to the same extent as the greater curve

#### EFFECT OF INJURY ON ERRORS OF REFRACTION

Loss of visual acuity following injuries in the neighbourhood of the head and eyes is frequently attributed by the patient to the accident

If a definite error of refraction can be discovered and corrected with glasses, such a defect cannot have been caused or aggravated by the accident.

The only exception is in the case of injury to the globe of the eye, causing an astigmatism by distorting the cornea by scarring. If no scarring is present, any astigmatism found cannot be due to injury

#### Glaucoma (Increased tension of the eyeball)

**CAUSES** Inflammation of the eye, particularly of the iris and ciliary body. In other cases it may be caused by worry, sleeplessness, indigestion, or other cause of venous congestion

**SYMPTOMS** Failure of sight, attacks of acute pain in the eye, vomiting; headache, appearance of rainbow colours round lights

**COMPLICATIONS AND SEQUELAE** Nil

**DURATION** The disease becomes progressively worse by repeated attacks. Each attack may last a few days at first, at intervals of many weeks or even months, but these attacks become gradually more frequent and more prolonged, and complete blindness may result

#### Iritis (Inflammation of the iris)

**CAUSES** Injury, syphilis, rheumatism, gout, diabetes, gonorrhoea, tubercle or "idiopathic," i.e. an apparently spontaneous inflammation without any discoverable cause. Infection of the other eye (sympathetic iritis).

**SYMPTOMS** Pain; photophobia; lacrymation, dimness of vision. The iris appears dull and may be irregular in shape

**COMPLICATIONS** Spread of infection to neighbouring parts, e.g. to the cornea, conjunctiva or lens. The condition may be followed

by adhesions between the iris and the lens, giving rise to permanent diminution in vision

**DURATION** In the acute form it may last several weeks, while in the chronic it may persist for many months

### **Keratitis** (Inflammation of the cornea)

**CAUSES** Local injury with ulceration (corneal ulcer), infection by organisms, syphilis (interstitial keratitis)

**SYMPTOMS** Pain, photophobia, lachrymation; dimness of vision The ulcer, if present, appears as a small depressed spot on the cornea It may heal, if small, with no appreciable scarring, but if large a scar is formed giving a white, hazy appearance to the part of the cornea involved

Interstitial keratitis is a general haziness of the cornea, and is usually due to syphilis It may cause complete blindness

**COMPLICATIONS** Perforation of the cornea, formation of pus in the anterior chamber (hypopyon), iritis, and panophthalmitis

**DURATION** A simple ulcer may take three to eight or ten weeks to heal If extensive or associated with complications the disability may last for months

### **Ocular Paralysis.**

Paralysis, or weakness of one or more muscles of the eyeball, is a not uncommon condition, and is the ordinary cause of a squint in children In these cases some error of refraction causing abnormal strain on the eye muscles is usually present as well It can, in early cases, be corrected by wearing glasses

A squint (*Strabismus*) developing in adults is sometimes due to paralysis of one or other muscle of the eye, either caused by nerve injury or disease, but before the squint is developed symptoms of such paralysis occur

**SYMPTOMS** Loss of power of movement of the eye in the direction normally produced by the paralysed muscle; double vision (diplopia), particularly in certain positions of the eye Giddiness and feelings of sickness may be caused by the diplopia

**CAUSE** Paralysis of the third, fourth or sixth cranial nerves, i.e. those innervating the eye muscles may be due to disease or injury anywhere along their course from the brain to the eye

Injury, such as fracture of the skull or even severe concussion, may produce sufficient damage to the nerve to cause paralysis

Cerebral haemorrhage (*qv*) may, if situated in the right region of the brain, give rise to such a paralysis

Of diseases, the commonest cause is syphilis. Others are tumours, rheumatism, diphtheria, gout, meningitis.

**DURATION** Depends entirely on the cause. In cases due to concussion, the paralysis is transient and may completely disappear in six or eight weeks. In cases due to other causes the duration is indefinite, and may be permanent. Owing to the diplopia, disability for performing work, more particularly of special kinds, may be serious and necessitate wearing a shade permanently over the affected eye, thus rendering the patient for practical purposes, a one-eyed man.

### **Optic Neuritis (Inflammation of the Optic Nerve)**

**CAUSES** Diseases of the brain and its coverings, syphilis, lead poisoning, occasionally caused by rheumatism and nephritis and toxæmia

**SYMPTOMS** Failure of vision, partial or complete

**COMPLICATIONS AND SEQUELAE** Blindness may follow

**DURATION** Indefinite; prognosis always bad, frequently followed by blindness.

### **Retinitis (Inflammation or degeneration of the retina)**

**CAUSES** Nephritis; diabetes, syphilis, haemorrhagic (due to the rupture of the blood-vessels in the eye in patients with high blood pressure, e.g. in elderly individuals).

**SYMPTOMS** Diminution of visual acuity, irregularity of the field of vision, i.e. if the patient looks straight ahead only part of the normal area of vision is seen.

**COMPLICATIONS AND SEQUELAE** Blindness may follow

**DURATION.** Indefinite. Varies according to cause.

## CHAPTER XXIX

### DISEASES OF THE NOSE

#### Adenoids.

AN overgrowth of lymph tissue at the back of the nose, arising from the naso-pharynx

CAUSE Developmental

SYMPTOMS These are almost entirely those of nasal obstruction, and their severity depends on the extent of the overgrowth and consequent obstruction to the passage of air through the nose

The most important symptoms of nasal obstruction are—

- 1 Difficulty or inability to breathe through the nose
- 2 Nasal tone to the voice
- 3 Snoring

These are followed by persistent mouth breathing, irritation of the throat with consequent enlargement and inflammation of the tonsils owing to their infection from dust-laden air; bronchial irritation and catarrh and other lung complaints, deafness owing to obstruction of the Eustachian tubes which open at the back of the naso-pharynx, inflammation of the middle ear (otitis media).

In children owing to the deafness, growth in intelligence is slow, and owing to the lack of the normal effort required by nose breathing, the chest is poorly developed. The child has a vacant look

SEQUELAE See symptoms which may persist

DURATION The symptoms persist and become worse until the adenoids are removed. This simple operation incapacitates a child for a day or two, and an adult for three or four days

The frequent association of enlarged tonsils makes it usual for the removal of the tonsils to be undertaken at the same time, and thus, in an adult, may incapacitate for two to three weeks. In children the combined operation does not incapacitate for more than one week

#### Deflected Septum of the Nose.

The septum of the nose, instead of being in the middle line, bulges to one side or the other

**CAUSE.** May be due to a blow or to a faulty development

**SYMPTOMS** Those of nasal obstruction, i.e. stuffiness of the nose ; nasal catarrh ; chronic rhinitis (*qv*) , ulceration of the mucous membrane

**COMPLICATIONS** Nil, except persistence of symptoms

**DURATION** If the defect is only slight local treatment of the associated symptoms may give relief in periods varying from a few days to two or three weeks. In more severe cases the cartilaginous septum has to be removed from between the two layers of mucous membrane, which then fall into the middle line and maintain the partition between the two nostrils. Disability following this operation, two to three weeks

### Enlargement of Turbinate Bones.

The turbinate bones (see p 191) are sometimes abnormally large, and the mucous membrane over them may become congested and inflamed. This is particularly liable to occur if the septum is also deflected

**CAUSE** Developmental

**SYMPTOMS** Those of chronic rhinitis (*qv*) and partial nasal obstruction. There may be bleeding from the nose, nasal discharge, and chronic catarrh

**SEQUELAE** Chronic rhinitis

**DURATION** Indefinite, until the turbinate bones are removed. Such removal is usually not complete, but sufficiently extensive to give relief to the symptoms of obstruction

### Epistaxis (Bleeding from the nose)

This is a symptom which may be due to many conditions

1 In childhood it is frequently spontaneous, due to a simple congestion of the mucous membrane, and is of little importance

2 In elderly people it is sometimes due to high blood pressure, and may relieve the cerebral symptoms, headache, etc., which are associated with this condition

3 It may be due to growths within the nose, the commonest of which is nasal polyp (*qv*)

4 Ulceration of the nose due to tubercle or syphilis

5 It is a common symptom of fractured skull and injuries to the nose.

6 In otherwise healthy adults bleeding from the nose may occur, and the haemorrhage then usually comes from a spot in the mucous membrane on the septum near the nostril, and may recur at frequent intervals

**DURATION** Dependent on the cause It is seldom, if ever, disabling in itself

**Hay Fever.** (See p 214)

**Lupus.** (See p 208)

### **Polypi.**

These are rounded tumours attached by a stalk or "pedicle" to the walls of the nose or naso-pharynx

**CAUSE** Unknown, may follow chronic infection of the nasal mucous membrane

There are two main varieties · 1 Innocent, and 2 Malignant.

#### **1 Innocent—**

**SYMPTOMS** Bleeding from the nose (epistaxis), nasal obstruction causing difficulty in breathing through the nose and consequently mouth breathing This may be followed by soreness of the throat owing to irritation by the direct inhalation of dust-laden air, discharge from the nose, headache due to local congestion, deafness

**SEQUELAE** Chronic sore throat, tonsillitis, otitis, bronchitis, asthma

**DURATION** Symptoms persist until removal of the polypi. Disability in simple cases after operation is one to two weeks

#### **2. Malignant—**

**SYMPTOMS** These are similar to those caused by the innocent variety, but the growth is more rapid and leads to extensive destruction of the neighbouring parts unless it is early removed

**DURATION** Indefinite They are fatal unless removed early, and the disability following the operation may be four to eight weeks or longer, according to the severity of the operation

**Rhinitis** (Inflammation of the nasal mucous membrane)

This may be (i) Acute or (ii) Chronic

(i) *Acute* This is known as coryza (*qv*)

(ii) *Chronic*

**CAUSE.** Chronic irritation of the nasal mucous membrane, due sometimes to persistent congestion from the presence of adenoids, or other growths, or to inhalation of irritating vapours or dust. It occurs in two forms, in one of which the mucous membrane is thickened (*Hypertrophic Rhinitis*), and in the other the membrane is atrophied (shrunk). This form is known as *Atrophic Rhinitis*

**SYMPTOMS** In both forms there is a discharge which may appear through the nostrils, or pass down the throat from the back of the nose. The breath is foul-smelling. In the hypertrophic type there may be nasal obstruction. Cough due to irritation of the throat.

**COMPLICATIONS** Spread of infection from the nose to the ear via the Eustachian Tube, causing chronic otitis media, and to the air sinuses communicating with the nose, the chief of which are the Frontal Sinuses and Antrum of Highmore.

**DURATION** Indefinite. In its simple form (without complications) it is not usually disabling.

**Sinusitis.**

This is the name given to inflammatory conditions of the accessory air sinuses which communicate with the nose. (See p. 191)

The two main sinuses are the frontal sinus, situated just above the inner half of the upper border of the orbit and communicating with the upper part of the nasal cavities, and the antrum of Highmore, situated in the upper jaw and communicating with the lower portion of the nasal cavities.

**CAUSE** Almost invariably due to the spread of infection from the nasal cavities, or in the case of the antrum of Highmore, from a carious tooth.

**SYMPTOMS** Throbbing and a sense of fullness in the forehead or face, discharge of pus from the nose, rise of temperature.

**COMPLICATIONS** The infection may spread to the bones forming the walls of the sinuses causing "necrosis" (local death) of these bones. In the case of the frontal sinus the infection may spread to the coverings of the brain, giving rise to meningitis.

Septicaemia and pyaemia may develop if the condition is not treated effectively

**DURATION** In acute forms the patient may die of septicaemia or pyaemia unless the sinus is opened by operation and drained. Disability from this operation may last three to six weeks, but the operation is frequently followed by chronic discharge which may last for months, although in this stage there is usually no actual disability

In the chronic form, whether it is chronic from the beginning or follows the acute form, very little, if any, disability exists, but in order to effect a cure operation is frequently necessary. Disability resulting from this is from two to three weeks

### Ulceration of Nose.

**CAUSE** Commonly tubercle or syphilis

**SYMPTOMS** Discharge and haemorrhage from the nose, symptoms of phthisis or of general syphilitic infection

**SEQUELAE** Nil, apart from those of the cause

**DURATION** As the condition does not usually occur without constitutional symptoms of the disease causing the ulceration, and the ulceration in itself is not disabling, any disability there may be is measured in its duration by that of the associated general disease

The treatment for tubercular ulceration is removal of the affected portion of the nasal mucous membrane, and this operation may cause disability for two or three weeks



## CHAPTER XXX

### DISEASES OF THE THROAT (INCLUDING PHARYNX AND LARYNX)

#### Growths of Larynx.

THESE may be either innocent or malignant

CAUSE Unknown.

SYMPTOMS The commonest innocent growth is the papilloma (warty tumour) which may arise on or near the vocal cords, giving rise to symptoms of hoarseness or loss of voice and dyspnoea (difficulty in breathing)

Malignant growth (cancer) causes excessive ulceration of the larynx with usually great pain, loss of voice, and the general symptoms of cancer (loss of weight, general weakness, and toxæmia)

SEQUELAE Nil, apart from the after effects of the operation

DURATION Innocent growths will continue to give rise to symptoms until they are removed by operation, and disability following the operation varies from a few days to a few weeks, according to the extent of the operation Sometimes repeated small operations are necessary if there are many small growths In malignant disease of the larynx death results in a few months if operation is not performed If the growth is removed, the operation is usually of necessity so extensive as to render the patient permanently voiceless, or almost so, and after a convalescence of six or eight weeks, he is fit for only such work as is appropriate to a man with this infirmity In both simple and malignant cases a tracheotomy is often necessary, in the former case temporarily and in the latter permanently

Laryngitis. (See p 214)

Pharyngitis. (See p 253)

Quinsy. (See p 253)

### Retro-Pharyngeal Abscess.

A collection of pus between the mucous membrane of the posterior wall of the pharynx and the upper cervical vertebrae

**CAUSE** If accompanied by acute inflammation the cause is usually some injury (e g a scratch) of the mucous membrane, which becomes infected and forms pus

If chronic, i e if the abscess is unaccompanied by the signs of acute inflammation, the cause is usually tuberculous disease of the cervical vertebrae or of the lymphatic glands lying immediately in front of the vertebrae

**SYMPTOMS** Pain, especially on swallowing, obstruction of the breathing, the presence of a swelling at the back of the mouth and, in acute cases, rise of temperature

**SEQUELAE** Septicaemia, pyaemia, and complications due to the cause

**DURATION** In the acute form, two to three weeks after operation, which must be performed as soon as the diagnosis is made, as otherwise symptoms of septicaemia may develop

In chronic stage, the disability following operation is much the same as in the acute form, but there may be prolonged disability due to the underlying cause, e g tubercle of spine or of lymphatic glands

**Tonsillitis.** (See p 256)

### Tracheotomy.

This is the name given to the operation of making an artificial opening into the trachea through the neck. It is performed as a temporary relief to the breathing in cases of urgency, such as in cases of suffocation produced by the blocking of the larynx by the inflammatory membrane formed in diphtheria, or in other cases as a preliminary operation when extensive growths of the larynx are to be removed. It is necessary to perform a permanent operation if the larynx has to be removed for cancer.

A permanent tracheotomy is disabling in that it allows only sufficient air way for the ordinary needs of the body, and any real muscular exertion rapidly gives rise to dyspnoea.

Lung complications are common

**DURATION** As the operation is performed only to alleviate laryngeal obstruction, the disability of the patient is in most cases determined by the nature of the cause of the obstruction. Patients recover from the immediate effects of the operation in one to two weeks.

### **Vincent's Angina.**

An acute ulcerative tonsillitis, characterized by the formation of a pseudo-membrane resembling the true membrane of diphtheria, and general enlargement of the glands of the neck.

**CAUSE** Infection by a specific bacillus

**SYMPTOMS** High temperature, pain and soreness of the throat, yellowish discharge, enlargement of the glands in the neck which may lead to serious embarrassment of the breathing.

**COMPLICATIONS** Septicaemia, pneumonia, extensive destruction and subsequent scarring of the soft palate and fauces.

**DURATION.** Three to eight weeks (approx). May be fatal within a few days.

## CHAPTER XXXI

### DISEASES OF THE EAR

For the sake of simplicity, these may be divided into three groups—

- 1 Diseases of the external ear and meatus (orifice of the ear)
- 2 Diseases of the middle ear
- 3 Diseases of the internal ear

#### 1. DISEASES OF THE EXTERNAL EAR

These are almost confined to inflammatory conditions of the skin of the ear or of the meatus. Eczema is not uncommon and runs a course similar to this disease in other parts of the body (*vide* p 295)

##### Boils (Furunculosis)

CAUSE Infection of skin by bacteria

SYMPTOMS Boils are common and give rise to acute pain and throbbing in the ear, which is relieved at once by incision

SEQUELAE Nil

DURATION Seven to ten days

##### Earache.

This is a symptom and not a disease. It is so commonly met with that an indication of its common causes may not be out of place

CAUSES It may be caused by disease of the external or middle ear, e.g. wax, or inflammation of the external ear (it is commonly caused by a boil), otitis media (*qv*), by nasal obstruction causing blocking of the Eustachian Tube. It may be a reflex pain, i.e. the cause may be due to some irritation outside the ear itself such as inflammatory conditions of the throat or even to decayed teeth

SEQUELAE Depends on the cause

DURATION Depends on the cause

##### Exostoses.

CAUSE Unknown

SYMPTOMS An exostosis (*qv*) is a local overgrowth of bone forming a tumour which may, in the ear, be composed of either soft "spongy" bone or very hard ivory-like bone. They give rise

to few symptoms but may cause partial deafness on that side, and local irritation of the skin covering them may result. They may be removed by operation, but the ivory variety is so hard that it may be impossible to get rid of it

**SEQUELAE** Neuritis or other symptoms due to pressure by the growth may persist

**DURATION** Disability following operation, seven to ten days

### **Wax (Cerumen) in the Ear.**

**CAUSE** Normally a waxy substance known as cerumen, is secreted by the skin lining the orifice of the ear, and in some cases this accumulates and becomes hardened, giving rise to trouble

**SYMPTOMS** Deafness; irritation of the ear, buzzing and singing noises in the ear, feeling of fullness

**SEQUELAE.** If the condition is not treated, irritation of the skin lining of the meatus may follow, giving rise to inflammation and ulceration.

**DURATION** The symptoms are relieved at once by syringing out the wax

## **2. DISEASES OF THE MIDDLE EAR**

The only disease ordinarily met with in the middle ear is—

### **Otitis Media.**

This is an inflammation of the middle ear and occurs in two forms: (a) Simple catarrhal and (b) suppurative.

(a) *Catarrhal Otitis Media* A simple inflammation of the middle ear which may disappear under appropriate treatment, or may develop into the suppurative variety by the formation of pus

**CAUSE.** Sudden changes of temperature, spread of infection from the nose and naso-pharynx, scarlet fever, influenza, and other infectious fevers

**SYMPTOMS** Pain and sense of fullness in the ear, deafness, rise of temperature, particularly in children

**SEQUELAE.** In other cases a collection of fluid occurs in the ear which may discharge itself by rupture of the drum of the ear, giving rise to a thin watery discharge which may persist for weeks or months; pus may form and give rise to symptoms of Acute Suppurative Otitis Media.

**DURATION** The acute stage lasts four to seven days and then symptoms may completely disappear

*(b) Suppurative Otitis Media (Acute)*

**CAUSES** As for the simple catarrhal variety

**SYMPTOMS** These are similar to those of the catarrhal variety, but as soon as the pus collects the symptoms are much more acute, and then inflammation tends to spread to neighbouring parts, e.g. the bone surrounding the middle ear giving rise to necrosis (death) of the bone or to infection of the veins in the bone (septic thrombosis), this infection spreading to the veins within the skull and giving rise to cerebral symptoms of delirium, restlessness, severe headache, loss of consciousness; rapid pulse and high temperature. Or the disease may spread to the coverings of the brain (meninges) and give rise to symptoms of meningitis (*q v*)

**COMPLICATIONS** Acute mastoiditis (*q v*), septic cerebral thrombosis and meningitis (*q v*), septicaemia, cerebral abscess

**SEQUELAE** A chronic discharge (Otorrhoea) is a common result and may remain for months or even years and be a source of danger to the patient unless care in its treatment is exercised

**DURATION** In uncomplicated cases the symptoms are relieved as soon as the pus is discharged (either spontaneously or by operation). Disability following operation to free the pus may be estimated at from two to four weeks

*Suppurative Otitis Media (Chronic)*

This is extremely likely to follow the acute form and is associated with a chronic discharge from the ear, slight deafness, noises in the ear and possibly with vertigo (*q v*)

There is little disability or danger in this condition so long as the discharge comes away freely, but if this is stopped and accumulates in the middle ear, serious complications may result, similar to those met with in the acute conditions

**SEQUELAE** See complications of acute suppurative otitis media

**DURATION** Indefinite

## Mastoiditis.

**CAUSE.** Inflammation of the bone of the mastoid process. This is a process of bone extending from the skull downwards behind

the ear. It contains large air spaces which communicate with the middle ear. Suppuration is, therefore, extremely likely to spread from the middle ear to the mastoid cells, and this is the common cause of mastoiditis.

**SYMPTOMS** Those of acute otitis media and in addition pain, tenderness and swelling behind the ear over the mastoid process, temperature is usually very much raised with a rapid pulse.

**SEQUELAE AND COMPLICATIONS** As for acute otitis media.

**DURATION** Unless an operation is performed the disease spreads through the bones of the base of the skull and death is caused by septicaemia, meningitis, or cerebral abscess or thrombosis. After operation disability lasts for four to six weeks.

A chronic condition may follow the operation performed in the acute stage, and is characterized by persistent discharge from the ear, with possibly headache and vertigo. In such cases a more extensive operation on the bone may be performed, and disability from this may last for several weeks.

### 3. DISEASES OF THE INTERNAL EAR

Little is known of the diseases of the internal ear. Disturbances of the functions of the internal ear are not uncommon, and there is some evidence to show that such disturbances are associated with and due to inflammatory conditions of the internal ear, or to alterations in its blood supply.

The symptoms commonly attributed to internal ear disease are "nerve deafness," i.e. a deafness due to abnormality of the nerve endings of the auditory nerve in the internal ear. These can be detected by an aural surgeon and can be differentiated from those cases of deafness due to middle or external ear trouble.

Another common symptom is vertigo. This is due to interference with the semicircular canals in the labyrinth (*q v*). Noises in the head, nausea, and vomiting are other symptoms.

Internal ear trouble may follow infectious fevers, e.g. measles, scarlet fever, etc. Infection may spread from the middle ear. Continued doses of quinine may cause the symptoms.

**SEQUELAE.** Nil.

**DURATION** Indefinite.

**Meniere's Disease** (Disease of the Internal Ear)

**CAUSE** Usually described as being due to an effusion of blood, or serum, into the labyrinth (internal ear), or may be associated with high blood pressure

**SYMPTOMS** Giddiness, deafness, noises in the ear and vomiting.

**SEQUELAE** Nil

**DURATION** Indefinite

**Vertigo** (Auditory).

This is a feeling of giddiness in which objects appear to move round the patient, always in the same plane and in the same direction. This is a common symptom of Meniere's disease and may be caused by small haemorrhages into the internal ear, or some other abnormality of the circulation causing increased pressure in the labyrinth

**SEQUELAE** Nil

**DURATION** Indefinite

**Deafness.**

Difficulty or absence of hearing may be due to so many causes that it is impossible to enumerate them all. It is, however, so common and may be so readily simulated that a few notes on the subject may be useful.

Deafness may be due to a defect in any part of the auditory system, i.e. it may be due to local conditions in the external, middle, or internal ear, or to some affection of the auditory nerve. It needs a skilled aurist to distinguish between deafness due to nerve trouble and some forms of internal or middle ear disease. Many causes are easy to detect, e.g. wax in ear, otitis media with aural discharge, perforation of the drum, but cases of deafness with no apparent cause, only elaborate tests can elucidate.

The importance of being able to distinguish between a nerve deafness and one due to inflammatory or other changes in the ear itself is great, as on this alone may depend the possibility of proving or disproving that a deafness is due to injury.

**CAUSES** Some of the commonest causes of deafness are wax in ear, otitis media, inflammatory conditions of the external auditory canal, e.g. boils, sclerosis or thickening of the drum and other



tissues in the middle ear , fracture of the base of the skull ; catarrh of the Eustachian tube , adenoids and catarrhal conditions of the pharynx and nose The deafness of old age is usually due to the sclerosis that takes place in all the tissues as age advances

**DURATION** This varies with the cause

**DEAFNESS AND MALINGERING** Deafness is one of the easiest symptoms to simulate and, unless the malingerer is caught out by a lucky chance, one of the most difficult to disprove. Various tests are applicable which, if unilateral deafness is simulated, will readily detect the fraud, but they must be carried out by a skilled and experienced examiner, or else they may be worse than useless

It must be remembered, in connection with allegations of aggravation of deafness following injury, that a man's acuity of hearing depends to some extent on the " tone " of his nervous system. A man who is partially deaf becomes more so when tired, and it must therefore be admitted that a partial deafness may be temporarily aggravated by any profound nervous shock, and so by the shock following an accident. Unless direct damage is done to the ear itself, however, such aggravation is only temporary and disappears when the nervous shock passes off If it is alleged that such aggravation persists, the case must be regarded with the gravest suspicion as being of the malingerer type

## CHAPTER XXXII

### DISEASES OF THE SKIN

AFFECTIONS of the skin are among some of the commonest of diseases caused by industrial conditions

The handling of irritating dusts and liquids, or the exposure of the skin to irritating fumes are all prone to produce, in some cases acute, and in others chronic, inflammation of the skin. Such conditions are known under the collective name of dermatitis, which is literally an inflammation of the skin, and is a term which may be applied to an inflammation of the skin however caused.

It is impossible to describe in detail all the forms of dermatitis which may be caused by a man's occupation or arise spontaneously. It is, therefore, proposed in this short chapter to give a very brief account of the main skin diseases which may incapacitate, and indicate especially those commonly met with as the result of industrial conditions.

#### Acne.

Two forms of this disease are described, *Acne Vulgaris* and *Acne Rosacea*.

*Acne Vulgaris* is due to an infection of the skin by a specific microbe. The disease is characterized by the appearance of multiple small red pimples which may suppurate and develop a small yellow centre which discharges a little pus.

The formation of the pustules is usually preceded by the blocking of the sebaceous glands, "black-heads" being a common sign of this. The commonest situations in which it occurs are the face and back. It is only in severe forms that it is disabling, and then chiefly on account of its disfiguring effects.

DURATION Indefinite

*Acne Rosacea* is a condition similar to the *acne vulgaris*, but is more local in its distribution, and there is more induration and thickening of the skin and subcutaneous tissues. It is regarded

by some authorities as an entirely separate disease, and is called by them *Rosacea*

### **Baker's Itch.**

An eczematous condition of the skin, included under the schedule of industrial diseases (dermatitis), characterized by an irritating rash over the skin of the hands and forearms

It is undoubtedly caused by irritation from flour, and the irritation is probably a mechanical one. Some authorities hold that it is caused by the irritation of a specific protein in the flour to which the individual is peculiarly susceptible. In support of this view is the fact that a man may be employed in contact with flour for many years and then get a first attack

After the first attack the man is very liable to get others, and it is most unwise for him to continue at work in contact with flour.

Each attack may last many weeks or even months, and an important and unfortunate characteristic of the disease is that the skin may almost completely heal and then break out again as badly as at the first onset, even though the man be not, in the meantime, in contact with flour

### **Barber's Rash (Tinea Tonsurans)**

This is a form of Impetigo (*q v*) which starts by a small abrasion becoming infected and which spreads over the neighbouring skin, so as to form an extensive area of raw skin partially covered by dried scabs. It is named Barber's Rash, as this special form of impetigo is confined to the skin over the lower part of the face in its initial stages, and is undoubtedly in many cases caused by infection from an unclean razor. It is difficult to cure owing to the growth of the hair, which can only be cut short and not shaved, and so renders the application of ointments and lotions difficult. It may be spread by the use of towels, flannels, etc

DURATION Indefinite

### **Dermatitis (Industrial)**

The forms of skin trouble arising from industrial conditions of exposure to irritants are innumerable. The commonest is an eczematous condition which appears in the form of red patches of

varying shapes on the skin. The superficial layers of the dermis may then be shed and a raw surface discharging a thin watery liquid develop. Unless this is covered, it becomes infected and deeper ulceration results.

In other forms the skin appears to be scaly, and irritates, leading to scratching and so infection. The common sites are the hands, forearms, and face.

**DURATION** One to twelve months. Very likely to recur even if the irritant is removed.

### **Eczema.**

One of the commonest forms of skin disease. It occurs in two forms: (1) "Scaly" and (2) "Weeping." In either case the first symptom may be acute irritation of the skin, accompanied or immediately followed by the appearance of a rash, consisting of minute red spots. The superficial layers of the skin may then become scaly, when the condition is known as *Scaly Eczema*, or minute vesicles containing fluid develop, and these coalesce and discharge a watery secretion (*Weeping Eczema*).

These conditions may disappear completely with appropriate treatment, but if there is a poor blood supply, as, for example, in legs subject to varicose veins (varicose eczema), or the skin continues to be exposed to an irritant, e.g. dust or chemicals at work (industrial eczematous dermatitis), ulceration may follow and prove very intractable.

**CAUSES** Industries. Any which expose a man to irritating dusts and liquids may produce an eczema.

Common occupations which cause this disease are those of dyers, bleachers, french polishers, bakers, cotton workers, workers in lead, arsenic, mercury, and other metals.

**Other causes** Constitutional. It is a disease which may arise with apparently no cause. It is, however, frequently associated with such conditions as gout, diabetes, gastric disorders, and other diseases associated with disturbances of the absorptive and excretory functions.

It is frequently associated with local disturbances in the circulation, as, for example, with varicose veins.

**DURATION** It is very intractable, and may recur periodically.

No definite time can be given for each attack, which may last from one or two weeks up to ten or twelve months or even longer.

### **Furunculosis (Boils)**

Characterized by the appearance of scattered septic spots on the skin, which are red, swollen, and a little tender, and which may give rise to a discharge of pus

They may appear anywhere on the body, but the face, neck, and back are the commonest positions

**CAUSE** Infection of the skin by an organism (*Staphylococcus*) which usually gains entry through a hair follicle The condition spreads by the surrounding skin becoming infected by the discharge

It is usually associated with a generally low state of health

**DURATION** Two to six weeks or longer

### **Impetigo.**

Characterized by the development of small "raw" spots on the skin, which become covered with scabs The scabs, when removed, leave a moist surface which again dries and another scab is formed

The commonest parts of the body to be affected are the scalp and face, particularly near the corners of the mouth It is commonest among children, particularly if they are neglected and dirty, it is probably started by scratching It is contagious

Industrial dermatitis may assume an impetiginous form

**DURATION.** Under proper treatment by cleanliness, removal of irritants and local application of suitable lotions and ointments, the condition will clear up in two to six weeks

### **Itch (Scabies).**

Characterized by an intense irritation of the skin, starting usually between the fingers It is caused by a minute organism which burrows beneath the superficial layers of the skin and leaves a track (run) which can readily be identified

Any part of the body may be affected, and the characteristic appearance of the skin, apart from the "runs," is of small spots, each one covered by a minute scab.

Scratch marks are very common It is very contagious

**DURATION.** Under effective treatment, one to two weeks

**Lupus.** (See *Tuberculosis—Skin*)

### **Psoriasis.**

Characterized by the appearance of circular patches of inflamed skin covered by silvery white scales. The patches most commonly occur in front of the knees and behind the elbows, but may occur elsewhere, chiefly on the extensor surfaces of the limbs.

**CAUSE** Unknown, but many patients have a gouty history or predisposition. It is said that an injury may give rise to the appearance of a patch of psoriasis if the skin is injured by a scratch, in a patient who has already suffered from the disease.

**DURATION** The condition is not generally incapacitating. If, however, the patches become cracked or infected, the patient may be laid up for a few days. It is a very intractable disease and may last for years.

### **Ringworm (Tinea Circinata)**

A contagious affection of hair-covered skin, characterized by the hair breaking off close to the root in circular patches.

The disease is caused by a minute parasite which may be identified microscopically. It is most common in children, but adults may be infected, and although not incapacitating in itself, difficulties arise in carrying on work owing to the risks of contagion.

The modern treatment by X-rays effects a rapid cure, usually after one or two applications.

### **Urticaria (Nettle Rash)**

Characterized by the appearance of raised whitish patches on the skin, accompanied by an intense irritation.

**CAUSE** Usually ascribed to the presence of some toxin in the circulation. This may be taken with food and may affect some individuals and not others. Shell and other fish may give rise to this disorder in susceptible patients.

Bacterial poisons may produce a like effect, e.g. it may be associated with septic tonsils or teeth.

**DURATION** Usually only transient, lasting a day or two, but may occur in repeated attacks.

## CHAPTER XXXIII

### INJURIES

THE main injuries to which the tissues of the body may be subject are as follows—

- I Wounds
- II Bruises (Contusions)
- III Sprains of joints
- IV Strained muscles or tendons
- V Ruptured muscles, tendons, and ligaments
- VI Fractures.
- VII Dislocations

It is intended here merely to give an indication, where this is possible, of the nature and results of these injuries, and the approximate times necessary for recovery

### I. WOUNDS

#### Varieties.

- (a) INCISED The edges are clean cut by a sharp instrument
- (b) LACERATED The edges of the wound and the deeper parts are torn, so that the edges are jagged and irregular
- (c) CONTUSED . The tissues are crushed, and as a rule the edges of the wound are irregular and lacerated.

#### Duration.

The healing of a wound depends on many factors, chief among which are (i) the absence of septic infection , (ii) the accurate apposition of the edges of the wound , and (iii) the vitality of the tissues wounded

- (a) Incised wounds (clean), seven to ten days is the average time taken
- (b) Lacerated (clean), ten to fourteen days
- (c) Contused (clean), two to three weeks

The above periods may be prolonged if the wounds are very extensive

## Sepsis.

If any variety of wound is infected by microbes at the time of the injury, and these are not destroyed early by the white blood corpuscles, they multiply and a reaction occurs in the wound, the tissues round which become red, swollen, and painful, and a yellow discharge (pus) is formed of dead and living bacteria and dead blood corpuscles and tissue cells

Such a wound is called *Septic* and inflamed

As a rule the onset of signs of inflammation occurs within forty-eight hours of the time of the infection, and pus may appear on the third day

These times are, however, only approximate, and signs of infection may appear within twelve hours, or may not occur for five or six days. This depends on the virulence of the microbe, and the patient's resisting powers

The time taken for a septic wound to heal depends on very many factors, and may be from two weeks to many months

Lacerated and contused wounds are more liable to become septic than incised wounds, owing to the lowered resistance of the crushed and torn cells in the edges of the wound

## Healing of Wounds.

A wound may heal in one of two ways—

(i) Directly, or, as it is called, "by first intention" This takes place if the edges of the wound are in close apposition, and the wound is not septic. Union is effected by the growth across of connective tissue cells and fibres

(ii) Indirectly, or by granulation tissue. This takes place if the edges of the wound are separated, and consists of the filling in of the gap by granulation tissue, which is a collection of blood cells and connective tissue cells into which blood-vessels grow from the surrounding tissues. This finally becomes converted into fibrous tissue or scar tissue

## Characteristics of Scar Tissue.

When scar tissue is first formed it is very vascular and therefore red, but as time goes on the blood-vessels disappear, and the scar contracts until it becomes bloodless, white, and firm



In extensive scarring, deformities may arise from this contraction.

In the early stage, if any tension is put on it, it will stretch, and the final condition will be a weak, soft scar, liable to injury and difficult to repair owing to its bloodless condition.

### Sequelae of Wounds.

These depend entirely on (i) the nature of the tissue wounded, (ii) the infection or not of the wound; (iii) the nature of the scarring

#### (i) THE NATURE OF THE TISSUE WOUNDED

Tissues vary greatly in their power of repair. Most tissues, e.g. skin and muscle, heal readily and rapidly, and the sequelae of such injuries depend chiefly on the amount of destruction, and on the nature of the scarring.

*Tendons*, as a rule, take longer to repair, and unless they are sutured, union may fail to occur owing to the separation of the divided ends, due to the contraction of the muscle attached to the tendon. Loss of power in the part moved by the muscle is, therefore, a common sequela of an injury to its tendon.

*Nerves*. The most serious sequelae follow injury to these structures for three reasons—

(a) Repair is usually very prolonged, varying from a few weeks to eighteen or twenty-four months.

(b) The injury to the nerve is frequently associated with paralysis of many muscles lasting until the nerve repair is complete.

(c) When healing is taking place, and after it is effected, the nerve may be acutely painful owing to the pressure of the contracting scar tissue on the nerve fibres.

#### (ii) THE INFECTION OF THE WOUND

This may give rise to many complications, such as local abscess formation, gradual and extensive destruction of local tissue, involvement of nerves and blood-vessels, so that the former may be acutely painful owing to a "neuritis," and the latter may be eroded, giving rise to "secondary haemorrhage." Secondary haemorrhage may come on at any time after sepsis has once set in. It is fortunately rare. Septicaemia, pyaemia, local sloughing and gangrene may all follow a septic wound.

### (iii) NATURE OF THE SCARRING

This is, perhaps, one of the commonest causes of disability following wounds. The cause of the disability may be (a) the stretching, or (b) the contraction of the scar.

(a) If a scar is subjected to tension in the early stages, it stretches and may be followed by loss of power if the scar occurs in muscle or tendons of a limb, or in rupture (Ventral hernia) if it occurs in the abdominal wall.

(b) If the scar is an extensive one, as in the case of severe contused wounds, or wounds in which very much destruction of tissue has occurred, when it contracts it will cause deformity and interfere with the proper function of the parts involved, e.g. extensive scarring near a joint will prevent proper movement of the joint; if near or involving muscles or tendons the action of these will be interfered with.

### Adhesions.

This is, perhaps, an appropriate time to mention this subject, as adhesions are a common sequelae of wounds, and also of inflammation.

An adhesion is a binding together of two parts which should enjoy free movement. It is caused by fibrous or scar tissue.

The results of adhesions are limitation of the normal movement of the parts, and pain on movements being attempted.

The commonest positions in which adhesions give rise to disability are (i) between joint surfaces, (ii) between tendons and neighbouring parts, (iii) between muscles and neighbouring parts, (iv) between the bowel and the abdominal wall or contents.

The disability due to adhesions may be remedied by freeing the adherent parts either by (i) continuous massage and movements; (ii) forcible movements of the joints or tendons under an anaesthetic; or (iii) by operation, the adhesions being cut.

The results are very variable, and very frequently the adhesions re-form. If the formation of the adhesions has been associated with sepsis, sufficient time (often several months) must be allowed to elapse before any open operation is performed. Otherwise there is a great risk of the wound becoming re-infected.

Adhesions within the abdomen frequently occur as the result

either of inflammation or operations. The symptoms depend on the part affected. Pain of a dragging nature is common, and the symptoms are frequently alleviated by rest. Serious results, e.g. intestinal obstruction, may follow such adhesions.

## II. BRUISES (Contusions)

A bruise is caused by a crushing of the tissues, and is associated with damage to the cells of the tissues and to the blood-vessels. The result of the latter is that blood escapes and causes a swelling (extravasation of blood) by oozing into the tissues. The blood thus extravasated is gradually absorbed, the time taken depending entirely on the extent of the extravasation. The normal pigment of the blood is altered as the blood cells die and break down, and this pigment becomes freed from the cells and is in itself gradually oxidized and absorbed. It is to this escape and decomposition of blood pigment that the characteristic colours of a bruise are due. That they do not always appear is due to the fact that the bruising may be deep and all the pigment absorbed without reaching the surface.

If a large collection of blood occurs, causing a fluid swelling, and the blood is not merely "soaked" into the surrounding tissues, such a swelling is called a *Haematoma*.

A haematoma will gradually become absorbed, but the cure is accelerated by the withdrawal of the blood from the swelling, by means of a hollow needle and syringe.

**SEQUELAE** For effect of sepsis on bruises see below.

Bruising of a muscle or tendon may cause persisting pain on contraction of the part for some weeks, especially if the part is not rested completely in the early stages.

Bruising of bone may be followed by a persistent swelling of the periosteum (periostitis) causing prolonged disability and pain.

Bruising of a nerve may be followed by a neuritis, which may cause prolonged, almost indefinite, disability.

**DURATION** A simple bruise of small size may take from one to three weeks to disappear. Extensive bruising takes proportionately longer.

A haematoma may persist for months, or even years, unless the blood is withdrawn.

## SEPSIS IN RELATION TO BRUISING

A not uncommon sequelae of a bruise is an abscess. Even though the skin be not broken, the bruise, or haematoma, may become inflamed and infected with organisms, so causing inflammation and an abscess with all its dangerous results.

The infection in this case is derived probably from the blood stream, which the microbes may have reached in small numbers from a septic focus elsewhere, e.g. from a septic tooth, tonsil, or boil. When these organisms reach the extravasated blood, they are stopped and find a nourishing soil for their growth.

In this way inflammation of bone (osteitis), or of the bone marrow (osteomyelitis) may result from a comparatively trivial blow or injury giving rise to a bruise of the bone.

## III. SPRAINS

A sprain of a joint is caused by a momentary forcible separation of the joint surfaces, and is accompanied by stretching and sometimes rupture of ligaments and tendons.

**SYMPTOMS** Swelling, pain and weakness of the joint, with effusion of fluid round the joint and ligaments.

**SEQUELAE** Occasionally synovitis or osteo-arthritis may result from, or in the case of the latter, be aggravated by, a sprain. Persistent weakness of the joint may result, particularly if much strain is thrown on the joint soon after the injury.

**DURATION** From ten to twenty-one days. Longer if serious damage, e.g. extensive rupture, has been done to ligaments, or if the part has not been rested in the early stages.

## IV. STRAINED MUSCLES AND TENDONS

**CAUSE** Sudden excessive strain causing stretching of a muscle or tendon.

**SYMPTOMS** Pain on putting the affected part on the stretch or by contracting the muscle involved. Slight swelling and local tenderness may be present. Onset is associated with a sudden acute pain.

**SEQUELAE** Nil.

**DURATION** One to eight or ten weeks, according to the severity of the strain.

## V. RUPTURED MUSCLES OR TENDONS

**CAUSE** Direct injury, e g by a wound, or indirectly, e g a muscle or tendon may snap across if subjected to sudden and excessive strain

**SYMPTOMS** Inability and diminished power to move the part to which the muscle is attached Acute pain and the sensation of something snapping or giving way at the time of the accident A gap can frequently be felt between the separated parts of the muscle or tendon

**SEQUELAE** If a muscle is completely ruptured, the parts separate widely and do not unite unless sewn together, and then the scar is usually weak and liable to stretch

Suture of a tendon is followed by better results, but there is a tendency for the scar to stretch and for the tendon to become adherent

**DURATION** Indefinite

### Ruptured Ligaments.

**CAUSE** Severe wrenching of a joint

**SYMPTOMS** Pain and swelling over the injured ligament, Abnormal mobility of the joint which is normally controlled by the injured ligament

**DURATION AND SEQUELAE** There may be permanent weakness of the joint as the result of weak union of the ligament Disability must usually be anticipated to last several weeks (three to ten)

## VI. FRACTURES

A bone may be fractured in one of two ways, either by *direct* violence, i e by a direct blow and the bone is fractured at the site of the blow, or by *indirect* violence, i e by a force which, by twisting or bending, causes a fracture at some spot more or less remote from the point of application of the force

An example of the former is the fracture of a leg by the passage over it of a wheel of a heavy vehicle

An example of the latter is the fracture of a collar-bone, by a fall on the shoulder

Another interesting example of a fracture by indirect violence is the case of a bone fractured by muscular action, e g when a

knee cap is fractured by the pull of the quadriceps muscle in the effort made by a man to prevent himself falling.

### Varieties of Fractures.

Many classifications of fractures have been made, but the following varieties should be remembered

1 *Simple* The fractured ends of bone do not communicate with the air. A wound may be present as well, but in this variety the wound does not communicate with the fracture

2 *Compound* The fractured ends communicate, by means of an accompanying wound, with the air

3 *Comminuted* The bones are fractured in three or more pieces

4 *Complicated* The fracture is associated with injury to important adjacent structures, i.e. large arteries or nerves may be torn, or the fracture may involve a joint

5 *Greenstick* The fracture is incomplete, extending half way across the bone and then longitudinally, so that the bone is split as well. It is named greenstick as the fracture is similar to that produced in a green stick if it is forcibly bent

6 *Impacted* A fracture in which one of the broken ends is driven and fixed into the other

7 *Transverse, Oblique, Spiral, and T-shaped* These terms describe the line of the fracture, and need no explanation

8 *Spontaneous* Sometimes a bone will fracture with the most trivial violence or even apparently with none at all. This is known as Spontaneous Fracture. It sometimes, but very rarely, occurs in an apparently healthy bone. Usually some bone disease is present, which weakens the bone, thus causing the fracture. Malignant disease (Cancer) is a common cause

**SYMPTOMS AND SIGNS** The classical signs and symptoms of a fracture are (1) pain, (2) deformity, (3) swelling, (4) abnormal mobility of the parts, (5) loss of function of a limb, (6) shortening of a limb, (7) crepitus

**COMPLICATIONS AND SEQUELAE** Malunion and non-union (*q v*) See also *Compound Fracture, Repair of Fracture, and Complicated Fracture*. The commonest disability following a fracture is due to shortening of the limb or to deformity preventing the proper use of the limb. With regard to shortening, it should be emphasized that

this is not necessarily disabling. In the case of the arm, shortening is of little significance. In the case of the leg, shortening of less than one inch is not in itself disabling as this can be fully compensated by slight tilting of the pelvis. If the shortening of the leg is two inches or more, disability for climbing and for very heavy weight carrying will probably be present. This can be alleviated to some extent by wearing a thickened sole to the boot, but some clumsiness usually results.

**DURATION** See *Healing of Fractures* and table of periods of disability for common injuries.

### Repair of a Fracture.

A fracture is repaired by the formation round the broken ends of a firm substance called *Callus*.

Callus is granulation tissue (see *Healing of Wounds*, p. 299), in which bone cells are deposited, thus giving solidity. The callus first formed when a fracture is being repaired is called *Temporary Callus*, and is deposited in a sheath-like manner round the fracture and also within the medulla, forming a sort of plug at the site of the fracture. This temporary callus is later absorbed, but before this takes place a very hard form of callus, the *Permanent Callus*, is deposited between the fracture ends, and this forms the ultimate bond of union.

The essential conditions for the repair of a fracture are—

- 1 Immobilization of the fracture.
- 2 A good blood supply
- 3 Absence of septic infection
- 4 Apposition of the fractured ends of bone.

If the first of these is not attained, one of three results may follow—

(a) The union may take place by the formation of fibrous tissue instead of bony callus. The union is then very weak and is called *Fibrous Union*.

(b) No sort of union may occur (*Non-union*), and in some cases a space containing fluid may develop between the fractured ends enclosed by fibrous tissue. This is termed a *False Joint*.

(c) If bony union occurs it usually happens that, owing to the lack of immobilization, the fracture unites in a bad position. This is known as *Mal-Union*.

If the second condition is not present, the result is usually either Non-Union or *Delayed Union*, i.e. the time taken for consolidation of the site of the fracture may be twice or three times normal

If sepsis is present, as is very likely to be the case in compound fractures, the result is usually delayed union, and sometimes mal-union owing to the difficulty of keeping the bones in good position, the presence of the wound rendering the application of splints difficult. In other cases the infection of the bone may cause a local inflammation of bone (*Osteo-Myelitis*, *q v*), and death of small portions of bone which have to be removed. Such a portion of dead bone is called a *Sequestrum*, and if it is not removed, the overlying wound will continue to discharge indefinitely

### Special Fractures.

As it is not proposed to give detailed descriptions of all the fractures met with, the following are selected owing to their common occurrence or special importance—

#### COLLAR BONE

This bone is usually fractured by indirect violence from a fall on the shoulder. The bone fractures in its middle or outer third. It is sometimes followed by limitation of movement of the shoulder, if the fragments are not set in good alignment.

*Period of disability* usually Total, four to six weeks Partial, eight to ten weeks

#### HUMERUS

1 *Upper End* A fracture in this position, being close to the shoulder joint, is very liable to give rise to permanent limitation of movement in this joint, owing to (a) displacement of the upper fragment, (b) adhesions forming round the joint, and (c) the formation of excessive callus, which mechanically prevents free movement.

2 *Middle* The special importance of this fracture is the frequency with which the musculo-spiral nerve of the arm is damaged at the time of the accident. This nerve is particularly liable to be injured in these cases, as it winds round the shaft of the bone in close apposition to it.

The result of injury to the nerve is wrist drop, owing to paralysis



of the extensor muscles of the wrist, which is extremely disabling. The duration of this disability depends on the extent of the damage to the nerve. This may be a mere bruising, when the wrist drop may disappear before the fracture is firmly united. The nerve may be stretched, when recovery from the wrist drop may take several months, or the nerve may be completely severed, in which case recovery will not occur at all unless the nerve is repaired by operation, when recovery may take six to twenty-four months.

**SKULL** A fracture of the *base* of the skull is a serious condition as it is frequently accompanied by damage to the internal and middle ear, on one or both sides. Partial deafness and giddiness may result. The violence causing the injury is in nearly all cases sufficient to give rise to severe concussion, and persistent headache and giddiness are common. One or more of the cranial nerves may be injured, or the brain may be lacerated.

*Period of disability* In young individuals Total, three to six months Partial, three to six months

As age advances the prospect of complete recovery becomes more remote, and such recovery after the age of 50 is unusual.

A fracture of the *Vault* of the skull may be serious if—

- 1 It is compound
- 2 It is *depressed*, i.e. one of the fractured edges is pushed inwards so as to press upon the brain
- 3 It is accompanied by severe concussion

If the fracture is in the neighbourhood of the motor area (*q.v.*), damage to this may result in paralysis of part or the whole of a limb, or, by the formation of scar tissue or blood clot, causing irritation of the motor nerve centres, a form of epilepsy known as *Jacksonian Epilepsy* (*q.v.*) may be produced.

*Duration of Disability.* In simple cases—Total two to three months (Not depressed)—Partial. two to three months

It is impossible to give any approximate period for complicated cases

#### COLLES' FRACTURE

This is the name given to a fracture across the lower end of the radius, about  $\frac{1}{2}$  in. above the wrist joint. It is caused frequently by a fall on the outstretched hand, or by the back-firing of a motor

engine If the deformity is fully corrected, the result is usually good, but if the fracture unites with any appreciable deformity of the wrist, the result may be extremely bad and the grip very seriously and permanently weakened The hand is usually displaced backwards and outwards (towards the thumb side)

*Disability* Total six to eight weeks Partial. six to eight weeks

#### CARPUS

*Cause* Direct blow on the small bones of the carpus, commonly due to back-firing of a motor-car engine

*Symptoms* Pain, swelling and deformity of the hand near the wrist, weakness of grip, pain on movement of the wrist X-ray examination is frequently the only means of diagnosis

*Sequelae* Nil, apart from persistent weakness of the grip

#### PHALANX

*Cause* Usually direct blow

*Symptoms.* Loss of use in the digit; swelling, pain and other sign of fracture (*q v*)

*Sequelae* Owing to the frequency with which the fracture involves one of the joints of the fingers or toes, permanent stiffness is a common result In the case of the great toe, this may result in a permanent limp In the case of the finger, in permanent slight weakness of the grip If the stiffness is complete, it is frequently advisable to amputate the finger (See *Deformities*)

#### PELVIS

This is a serious injury for three reasons—

1 The violence necessary to fracture the pelvis is very great and the degree of shock is usually profound

2 Damage to the pelvic organs (rectum, bladder, and urethra) is frequently caused at the same time

3 As the whole weight of the body is borne by the pelvis, pain and incapacity resulting from it may be very prolonged

*Duration and Disability* Total six months Partial. indefinite

#### THIGH

A fracture of the neck of the femur is an important fracture owing to its frequent occurrence in elderly people as the result of

slight violence It may be caused by a fall on to the side of the hip joint or even by a twist of the leg in old people

The disability resulting from it may be slight or severe, according to the amount of displacement Owing to its occurrence in elderly people, who are prone to get congestion of the lungs if long confined to bed, it may indirectly prove fatal

*Period of disability* in favourable cases    Total    three to six months    Partial    three to six months

#### PATELLA.

Cause may be direct violence when the fracture is usually comminuted. If, as is usual, it is caused by sudden muscular strain, i.e. indirect violence, the fracture is transverse and considerable separation of the fragments is present. This necessitates operation for wiring the fragments together

*Disability*    Total    six to eight weeks    Partial.    six to eight weeks

Permanent weakness of the knee joint results if the fragments are not wired accurately, and fibrous union occurs

#### OLECRANON

Caused either by a fall on to the elbow or by sudden contraction of the triceps

The upper fragment is small, and the fracture is transverse, involving the elbow joint

It is usually necessary to wire the fragments, owing to the separation caused by the triceps pulling on the upper fragment Owing to the formation of callus, the full extension of the elbow is often prevented, but this is not usually sufficient to cause permanent disability

*Duration of Disability*    Total    six to eight weeks    Partial  
six to eight weeks

#### POTT'S FRACTURE

This is a fracture of the lower end of the fibula, usually 3 or 4 in above the ankle joint

It is usually caused by a fall with the foot twisted, and the foot is displaced outwards This is usually easily corrected, but if the fracture unites with this deformity, the function of the ankle and

foot may be seriously and permanently impaired. This result is caused by the transference of the weight of the body to the inner border of the foot, thereby causing gradual flattening of the arch of the foot, giving rise to permanent lameness.

*Disability* Favourable cases—Total two to three months  
Partial six to eight weeks

#### METATARSAL

This bone may be fractured by direct or indirect violence, i.e. by a direct blow or crush, or by a twist of the foot.

*Symptoms* Those of fracture (*qv*), inability to bear any weight on the front of the foot, and possibly, but not commonly, deformity.

*Complications* Apart from those present if the fracture is compound, the only bad after-effects are those of continued pain, and if there is much displacement, permanent limping.

*Duration* Six to twelve weeks, but the fracture is one which may give rise to pain and limping over a long period, as the whole weight of the body is transmitted through the metatarsals, and in consequence a great strain is thrown on the fracture.

#### RIBS

The cause is usually direct violence. One of the fractured ends may damage the lung. Pain on movement of the arm and on breathing may persist for a long time.

*Disability* Total three to six weeks. Partial three to six weeks.

#### SPINE

If the spinal column, e.g. one or more vertebrae, is completely fractured, the result is usually that the spinal cord is either completely severed or compressed.

If the former, complete paralysis of the parts of the body below the level of the fracture results, and this is permanent. If the cord is only compressed, it is possible for some recovery to take place, but the outlook for any permanent return of working power is remote.

If the fracture is high up in the cervical region, death follows rapidly owing to paralysis of the muscles of respiration. If lower

down, loss of control of the bowel and bladder is common and death may follow months later, owing to infection of the urine in the bladder.

As a fracture of the vertebrae usually involves the joint between two neighbouring vertebrae, the injury is usually called a fracture-dislocation

## General Remarks on Fractures.

### EFFECT OF AGE

In early life bone is soft, owing largely to the great vascularity demanded by the exigencies of growth. In old age the living parts of the bone become wasted and the bones become more brittle

A child's bones will bend, but if the force applied is sufficiently great, a fracture will occur. This is sometimes of the Greenstick variety, owing to the softness of the bone. Such a fracture is not met with in adult life or old age

In old age the bones may be so brittle as to fracture with the most trivial injury. In such cases, repair is usually delayed owing to the poor blood supply, the blood-vessels of the bones, as elsewhere in the body, becoming brittle and degenerate in old age

### DISABILITY FOLLOWING FRACTURES

Apart from obvious considerations of the position and severity of a fracture, the resulting disability depends to a very great extent on the efficiency of the treatment

In the case of no other variety of injury can bad treatment give rise to such disabling results

The essential points in the treatment are—

- 1 X-ray examination
- 2 "Setting" the fracture
- 3 Second X-ray examination
- 4 Immobilization
- 5 Early massage

With regard to the setting of the fracture, an anaesthetic is frequently necessary, and in some cases the bones cannot be accurately set unless they are held together by metal plates and screws

The question of the necessity for the removal of the plates and screws is often raised. In the majority of cases, the need for this never arises. If, however, any infection by microbes occurs near the site of the plate, the latter will probably have to be removed. The necessity for removal is, therefore, more common in cases of compound than simple fracture.

Fractures likely to give rise to disability lasting beyond the time given for the special fractures mentioned above are—

- 1 All compound fractures
- 2 Fractures involving joints. Permanent partial disability frequently follows these.
- 3 Fractures involving large nerves. A common example is the injury to the musculo-spiral nerve of the arm in cases of fracture of the middle of the humerus. This gives rise to wrist-drop, and the effects may be very prolonged, if not permanent.
- 4 Fractures in debilitated or senile patients.
- 5 Malunited fractures.
- 6 Fractures in parts of the body subject to particularly heavy strain, e.g. the pelvis or small bones of the foot.

## VII. DISLOCATIONS

A dislocation is the displacement of one articular surface in a joint from the other. A dislocation may be partial or complete. If only partial the condition is sometimes termed a *Subluxation*.

It is obvious that a dislocation must be accompanied by damage (usually complete rupture) of one or more of the ligaments that hold the joint surfaces in their normal position.

It is largely on the degree of this associated damage to soft parts that the duration of disability from a dislocation depends, as the joint, after the dislocation is reduced, will remain weak until the ligaments are soundly healed. In addition to this, the disability depends on the joint affected, and the ease with which reduction can be effected.

Generally speaking, dislocation of the joints of the lower limb cause more prolonged disability than in the case of those of the upper limb, owing to the heavier strain thrown on these joints in the performance of their normal functions.

### Difficulty in Reduction.

The articulations of the clavicle are, perhaps, the best illustration of this.

If the sterno-clavicular joint, or acromio-clavicular joint, is dislocated, although it is a simple matter to replace the bones in their correct position, it is a difficult matter to keep them there, and, in fact, this may be impossible. Disability arising from this injury may, therefore, be out of all proportion, in its duration, to the apparent triviality of the injury.

### Dislocation of the Semilunar Cartilage of the Knee.

This is a special dislocation which may be mentioned here. It is usually caused by a sudden twist of the knee, and results in a partial or complete displacement of either the internal or external cartilage (usually the former). The accident is accompanied by acute, sickening pain, and the knee usually remains fixed or "locked" in a position of semi-flexion. The joint remains in this position until the cartilage returns to its normal position, which it usually does, sooner or later, either spontaneously or by manipulation.

The tendency is, however, for the cartilage to continue to slip out of position and give rise to recurrent attacks of "locking" of the knee. An operation for the removal of the cartilage is frequently the only cure. The result of this operation is usually complete restoration of the function of the joint.

*Period of Disability* Indefinite until operation is performed  
After operation—Total four to six weeks Partial Four to six weeks

It must be remembered that any dislocation is liable to recur if the affected joint is strained within a short time after the first dislocation, owing to the weakness of the ligaments. It is, therefore, inadvisable to over-persuade men who have met with this accident to return to heavy work too soon.

For periods of disability in the common dislocations, see p 327

### Injuries of Chest.

#### I. BRUISING.

*Symptoms* Similar to bruising elsewhere in the body. Owing to the muscles of the shoulder arising from the chest wall,

movements of the shoulder may be painful. There may be pain on coughing or taking a deep breath. Owing to the proximity of the ribs to the surface, these are frequently bruised and the symptoms may for this reason be prolonged.

*Complications* In women the breast may be injured (See *Breast*). A large haematoma may be caused, giving rise to prolonged disability unless the blood is removed by aspiration.

Cases sometimes occur in which a pleurisy or pleural effusion follows a severe bruising of the chest wall. Such cases should be regarded with the gravest suspicion, and the complication should be admitted as being due to the injury only if the signs start within a day or two of the injury, and at the same spot. Pleurodynia (*qv*) sometimes occurs.

*Duration* In simple cases from a few days to two to three weeks. In others, e.g. severe bruising of the pectoral or back muscles, disability may last five or six weeks.

## 2 WOUNDS

These, if they do not penetrate within the chest cavity, follow the usual course of such injuries. (See *Wounds*.)

*Penetrating* If the wound penetrates into the chest cavity, serious symptoms may develop. Both pleura and lung may be injured.

*Special Symptoms* *Injury to Pleura* If the *pleura* is wounded, the air may enter between the two pleural layers from outside, and cause the lung to collapse and air to fill a varying portion of the pleural cavity (pneumothorax). Breathlessness, embarrassment of the heart's action, and sometimes displacement of the heart may follow. There may be bleeding into the pleural cavity (haemothorax), or a mixture of air and blood may be present (haemo-pneumothorax).

If the wound is infected, septic pus may collect in the pleural cavity (empyema), or it may be associated with air as well (pyo-pneumothorax).

*Duration* All these conditions are serious to the life of the patient, and may terminate fatally. In any event disability will be prolonged, two to six months, and permanent partial disability may remain owing to impairment of function of that side of the chest owing to adhesions.



*Symptoms Injury to Lung* If the lung is injured, any of the above symptoms may be present, and, in addition, the patient will cough up blood (haemoptysis) and an abscess may develop in the lung. It may happen that air is forced from the lung through the wound and penetrate into the soft parts of the chest wall. The result is a distension of these tissues with bubbles of air (Surgical Emphysema)

The lung is sometimes injured by a fractured rib (*qv*) being driven into it. This injury may be repaired within a few weeks, or in some cases any of the above complications may develop and give rise to prolonged and possible permanent disability.

*Duration* It is impossible to give any approximate time of disability for such an injury, and it is entirely dependent on the local condition and severity of the injury. Three to twelve months may be regarded as a reasonable estimate.

#### DISEASE OF PLEURA AND LUNGS FOLLOWING INJURIES

It must be recognized that damage to the pleura or lung may be the starting place and exciting cause of a Pleurisy or Tubercular disease. For such a connection to be established, the disease must start at the site of the injury. It is possible that in severe chest injuries, i.e. if many ribs have been fractured and the chest is seriously deformed, the ventilation of the lung may be so imperfect as to predispose towards the development of pulmonary tuberculosis on that side. Such impairment of ventilation must be well marked for any such possibility to be seriously considered.

#### AGGRAVATION OF DISEASE

That tuberculosis or chronic lung disease of any kind may be aggravated by injury to the pleura or lung must be admitted, and if the lung itself is wounded, such a possibility must be seriously taken into account.

#### Injuries of Abdomen.

##### WALL OF ABDOMEN

*Strains* Being muscular the abdominal wall is subject to strains and rupture of muscular fibres, the course of which injuries is similar to those of similar injuries to other muscles (*vide Strains*)

The muscles of the abdomen are strongly contracted during heavy lifting, especially from a stooping position, and are frequently strained under these circumstances

Tearing of the fibres in the groin during a heavy strain is not uncommon, and may give rise to a weakness in this region, and a hernia may subsequently appear without any appreciable additional strain. To this is due the appearance of some hernias a week or two after a strain which has not been sufficient to cause rupture to appear at once

*Wounds* The only special feature of wounds of the abdominal wall is the scarring. If this is clean and small no ill-effects are likely to follow, but if the wound has been septic, or for any other reason the scar is a broad and consequently weak one, this may subsequently stretch and give rise to a rupture (Ventral hernia)

The period of disability in all wounds of the abdominal wall that damage the muscle is longer than in other parts of the body, on account of this tendency to stretching of the scar

Accidental wounds are rare and usually accompanied by injury to the abdominal contents. Disability may last from two to six months

#### ABDOMINAL CONTENTS

*Ruptured Viscera* Any organ contained in the abdomen may be damaged by a direct and powerful blow, but blows of moderate severity are not sufficient to cause serious visceral injury unless the recipient is unprepared and the muscles are relaxed. The commonest cause of rupture of the solid organs, i.e. liver, spleen, kidneys, is a crush, e.g. if a man is run over

On the other hand, comparatively trivial blows have been known to cause rupture of these organs, even without any external sign of bruising of the abdominal wall or back

*Symptoms of Rupture of a Solid Viscus* Apart from the kidneys, rupture of which causes blood to appear in the urine, the only signs and symptoms are those of shock and internal haemorrhage (vide *Haemorrhage, symptoms*)

*Duration* In slight cases the ruptured viscus may heal spontaneously, and disability may be a matter of only a few (four or six) weeks. In severe cases an operation is the only means of saving

the patient's life, and in these cases the bleeding may be stopped by suture or plugging, but in the case of the spleen and kidneys it is frequently necessary to remove them completely.

In the case of the *Spleen*, removal is followed by no harmful effects, and the period of disability varies from six to twelve weeks

In the case of the *Kidneys*, it is, of course, possible to remove only one, and the immediate effects of this will pass away (provided the other kidney is healthy) in from six to thirteen weeks. On the other hand, some patients are found, after this operation, not to be so capable of prolonged heavy work as before, so that some degree of permanent partial disability may remain

In the case of the *Liver*, if the patient recovers after operation the period of disability is dependent on the degree of shock and loss of blood, varying from six to thirteen weeks

*Sequelae* Nil

#### *Rupture of Hollow Viscera*

The Stomach, Intestines or Bladder may all be ruptured by injury.

*Stomach and Intestines* These are usually ruptured by a direct blow, e.g. by the shaft of a van, a crush may cause rupture

*Symptoms* These are as for acute peritonitis (*q v*)

*Duration* As for acute peritonitis

*Sequelae* As for acute peritonitis

#### *Effect of Injury on Gastric or Duodenal Ulcer*

A direct blow may precipitate an attack of haemorrhage from a gastric or duodenal ulcer and may cause perforation

Although cases of perforation of such an ulcer have been reported following strain as opposed to direct injury, such cases should be regarded with the greatest suspicion, and the possibility should be admitted only if acute symptoms start *at once* after a *heavy* strain

For symptoms, duration, etc., see *Gastric Ulcer*

*Rupture of Bladder.* A bladder may be ruptured as a result of a fracture of the pelvis, such an injury either causing laceration of the organ by the fractured bone (rarely) or by the force of the blow or crush causing rupture of a distended bladder. It is rare for an empty bladder to be ruptured or injured

A rupture of a bladder may be complete when urine escapes into

the pelvis and peritoneal tissues (extravasation of urine), or incomplete when the wall of the organ is only partially injured. Apart from a direct crushing blow, a bladder, if full, may be ruptured by a fall from a height.

*Symptoms* Passage of blood per urethra, retention of urine; signs of pelvic peritonitis, shock and collapse.

*Duration* Operation is usually necessary to repair the damage. This is essential in complete rupture. Disability following this may be from four to eight weeks.

*Sequelae* Nil, unless extensive damage has occurred, when cystitis and intractable frequency of micturition may follow.

### Injuries of the Nervous System.

**BRAIN** (See *Concussion, Compression, Cerebral Haemorrhage*)

*Laceration of the Brain* Such an injury may occur as the result of a depressed fracture of the skull (*q v*)

*Symptoms* These depend on the part of the brain involved, and vary from general signs of cerebral irritation, restlessness, delirium, irritability during consciousness, to definite Jacksonian epileptic fits (*q v*)

*Duration* Indefinite

*Sequelae* Permanent ill-effects, such as continuation of Jacksonian fits, irritability, partial paralysis, headache, giddiness, loss of power of concentration.

*Contusion of the Brain*

*Cause* Blows on the head apart from, or accompanied by, fracture of the skull.

*Symptoms* As for laceration, only to a less marked degree.

*Duration* Six to thirteen weeks.

*Sequelae* Jacksonian epilepsy may follow, persistent headache, loss of power of concentration.

### INJURIES TO NERVES

*Cause* Nerves may be injured in four ways—

- 1 By contusion caused by a direct blow
- 2 By stretching
- 3 By partial division by cutting
- 4 By complete division by cutting

### 1. *Contusion*

*Symptoms* Local pain varying in severity, but sometimes extremely acute; pain radiating along the course of the nerve, varying degrees of paralysis in muscles supplied by the nerves.

*Duration.* Very variable, one to eight or ten weeks

*Sequelae* Neuritis (*q v*)

### 2 *Stretching*

Some nerves are liable to this injury, especially if they pass over a joint and this is violently or excessively moved.

A common position for this injury is in the neck where the roots of the nerves of the arm may be stretched if the head and shoulder are forcibly widely pushed away from each other, e.g. by a heavy object, such as a sack falling on to the side of the neck.

Another nerve liable to this injury is the sciatic nerve, which may be stretched when the hip is strongly flexed.

*Symptoms.* As for contusion and neuritis.

*Duration.* As for contusion and neuritis

*Sequelae.* As for contusion and neuritis

### 3 *Partial Division by Cutting*

*Symptoms* Partial paralysis or loss of sensation in the distribution of the nerve. Sometimes there is intense pain in the region of the injury, and this is common where the damage is being repaired, and may last indefinitely

*Duration* Varying with the amount of damage done to the nerve from one to twelve months or longer. If sepsis occurs recovery may be indefinitely delayed. Paralysis may be permanent and followed by contraction of the unparalysed muscles, so giving rise to deformity

*Sequelae* Neuritis. Changes in nutrition of the parts supplied by the nerve may occur, the skin may become hypersensitive and eczematous conditions or ulceration (so-called "trophic ulcers") may develop. It is occasionally necessary to operate to divide the nerve completely, remove the scar in the nerve (to which some of the above symptoms may be due), and to re-suture the nerve

#### 4 *Complete Division of a Nerve*

*Symptoms* Paralysis and loss of sensation in the parts supplied by the nerve

*Duration* The disability is permanent unless the ends of the nerve are sewn together (suture) After such an operation the disability may vary from three to twenty-four months All hope of recovery of a nerve should not be given up until the lapse of two years, provided signs of partial recovery are present

The period of recovery is almost invariably maximal if sepsis occurs, and disability in any event may be permanent

*Sequelae* Permanent paralysis, neuritis and persistent local pain, trophic ulceration and wasting of muscles, contracture of unparalysed muscles may follow with resulting deformity

#### SPECIAL NERVES

##### *Brachial Plexus*

*Cause* Injuries which may be due to overstretching or direct injury by wounds, or from pressure by a fractured clavicle

*Symptoms* Loss of power in the muscles of the shoulder and arm, the number of muscles involved depending on the number of nerves of the plexus injured

*Duration* Indefinite, complete recovery is rare The disability is usually severe enough to prevent the arm being used for heavy manual work

*Sequelae* See *Injuries of Nerves* (p 319)

##### *Musculo-Spiral Nerve*

*Cause* May be due to pressure on the nerve in the axilla (e g by pressure of a crutch, so-called "Crutch palsy") Is a frequent complication of fracture of the middle of the humerus as the nerve winds round the bone in the middle part of the shaft

*Symptoms* Paralysis of the extensor muscles of the wrist and fingers—"Wrist drop"

*Duration* See *Injuries of Nerves* (p 319)

*Sequelae* See *Injuries of Nerves* (p 319)

##### *Ulnar and Median*

*Cause* The ulnar nerve is sometimes injured by fractures of

the internal condyle of the humerus, more frequently by direct injury by wounds at the wrist

The median is most commonly injured by wounds in the front of the wrist joint.

*Symptoms* Paralysis of small muscles of the hand with consequent loss of power of gripping The median nerve affects the thumb side of the hand, and the ulnar the little finger side It is unnecessary to describe the details of the effect of the loss of gripping power, but in the case of injury to either of these nerves the gripping power is materially affected, and may be nil for all practical purposes Loss of sensation also occurs in the distribution of the nerves. (See Sect I)

*Duration.* See *Injuries of Nerves* (p 319).

*Sequelae.* See *Injuries of Nerves* (p 319).

#### REACTION OF DEGENERATION.

By this is meant change in the normal electrical reactions of the muscle, and this change may occur if the muscle has been paralysed owing to nerve injury for a long period. If it is present it shows that the muscle is incapable of recovery

### Injuries of Spinal Cord.

CONCUSSION (See *Diseases of Spinal Cord*)

#### COMPRESSION

*Cause.* The spinal cord may be compressed by haemorrhage or by pressure from a displaced vertebra

*Symptoms* Varying degrees of paralysis of the muscles below the level of the injury Such paralysis is generally incomplete, although some muscles may be completely paralysed Sensory disturbances are also present, but are complicated, and need not be described in detail The compression in cases of haemorrhage may pass off gradually, leaving little or no ill-effects, if, however, the nerve fibres in the spinal cord have been damaged by the pressure, a certain residue of permanent paralysis will remain

In cases due to pressure from a displaced vertebra, the symptoms will not pass off unless the vertebra can be replaced in position

*Duration* In cases of haemorrhage two to twelve months. In cases of displaced vertebra. Indefinite

*Sequelae* Permanent partial paralysis is common Interference with the functions of the bladder, which may lead to cystitis and nephritis

#### SECTION OF THE CORD

If a vertebra is so displaced as to destroy the nerve fibres wholly or in part, the symptoms of paralysis and sensory changes below the level of the injury will be permanent The nerve fibres of the spinal cord cannot recover when they have once been definitely severed

*Sequelae* Permanent, partial, or complete paralysis, and if the injury is higher up, death will follow owing to paralysis of the muscles of respiration Cystitis and loss of control of the bowel may occur

*Duration* Indefinite The patient usually dies of respiratory failure if the injury is high up, and of cystitis and nephritis if the injury is low down in the cord In the former case, death may result immediately or within a week In the latter, the patient, with care, may live for two or three years

#### Injuries of Back.

(See also *Fracture of Spine* and *Injuries of Spinal Cord*)

#### CONTUSION

*Cause* Direct blow on the back muscles

*Symptoms* Pain in the back, especially on stooping and rising, discoloration of the skin (the muscles may be bruised without the skin showing any signs), some thickening of the muscles may be felt

*Sequelae* Occasionally the kidney is damaged at the time of the accident, and urinary symptoms may occur These will show themselves at once In some cases pain may persist and a chronic inflammatory condition, accompanied by local tenderness, may develop similar to Fibrositis (*q v*)

*Duration* Varies from a few days to six or eight weeks, according to the severity of the injury

#### STRAIN

*Cause* Sudden excessive weight applied to the back muscles during contraction Usually caused by lifting or by an unexpected strain being thrown on the back



*Symptoms* Pain in the back on stooping and rising, local tenderness. To differentiate between this and lumbago (*qv*) may be difficult

*Sequelae.* Nil, apart from persistence of pain. In patients subject to lumbago or sciatica, a strain of the back is frequently followed by an attack of one or other of these.

*Duration* Indefinite. There is, perhaps, no common injury of which the future can be foretold with less assurance than in these cases. Disability may last from one to twenty-six weeks. If the case is unduly prolonged, some abnormality of the spinal column, such as arthritis, must be suspected.

**FRACTURE** (See *Fractured Spine* and *Injuries to Spinal Cord*.)

#### SACRO-ILIAC SUBLUXATION

By this is meant a partial displacement of the bone forming the joint, and it is sometimes the result of sudden twisting of the lower part of the spine, or of a crushing of the pelvis. It is an occasional cause of continued pain in the back following bad injuries, and the pain may be relieved by manipulation of the joints, the effect of such an operation being sometimes immediate.

A warning, however, must be given that there is a tendency to attribute all persistent back pain to this condition, and in a very large number of cases this is quite unjustified. The X-ray examination is sometimes helpful, but is often misleading owing to the difficulty of getting an accurate comparison between the two joints. It is only in cases where the pain is persistent in the neighbourhood of the joint, and where some bony irregularity can be felt, or where the X-ray examination is unequivocal, that a diagnosis is justified.

If manipulation fails to relieve the pain, the symptoms and consequent disability for heavy work may persist indefinitely.

#### Injuries of Testicle.

A blow on the testicle may cause—

##### I SWELLING OF THE TESTICLE (Orchitis)

*Symptoms* Pain and swelling of the testicle, dragging pain in the groin. In the initial stage the shock caused by the blow may be very profound.

*Duration.* One to six weeks

*Sequelae* Nil, except that a blow on the testicle may be the exciting cause of a tuberculous orchitis or epididymitis

## 2 HAEMORRHAGE INTO THE TUNICA VAGINALIS (Haematocele)

*Symptoms* Similar to those of Orchitis above.

*Duration* Three to eight weeks

*Sequelae* The swelling and symptoms may persist if the haematocele is of large size and necessitates operation. The testicle may atrophy. Disability following this is from two to three weeks.

If the injury is in the nature of a wound, it is usually of a lacerating character and may cause extensive damage to the testicle.

The symptoms and duration of disability are those due to the wound itself and are similar to those of wounds elsewhere.

*Sequelae* The only common sequela, apart from sepsis, etc., common to all wounds, is sloughing or atrophy of the testicle.

**STRAINS** It is often alleged that a swelling of the testicle is caused by a strain. This idea is probably due to the fact that symptoms of an orchitis may first arise while a man is doing heavy work, as the dragging pain, so common in cases of orchitis, is likely to be more noticeable at such times. A simple orchitis is probably never due to a pure muscular strain. If the swelling is due to a haematocele, there is a possibility of a strain by causing increased venous congestion giving rise to such a haemorrhage.

## Burns and Scalds.

**SYMPTOMS** These are due to three causes—

1 Shock (*q v*), which varies directly with the extent of the skin affected

2 Sepsis (*q v*)

3 Interference with the functions of the parts burnt, e.g. if muscles are affected, weakness of the limb follows; if the eye, blindness or interference with vision, etc.

Burns are classified as follows—

1st degree Where the skin is reddened only.

2nd „ Where the superficial layers of the skin are affected and blisters are formed,

3rd degree	Where the superficial layers of the skin are destroyed.
4th „	Where the whole thickness of the skin is destroyed
5th „	Where the muscles are burnt
6th „	Where the whole limb is charred

**SEQUELAE** Sepsis with pyaemia or septicaemia ; contraction of the scar giving rise to deformity , operations for skin grafting may be necessary.

**DURATION** Depends entirely on the degree and extent of the burn If blistering alone has occurred, two to three weeks is usually sufficient, provided sepsis does not occur If the whole skin is destroyed, disability may be permanent owing to scarring, and in any event six or eight weeks is the minimum time for recovery if the burn is at all extensive

### Shock Following Injuries.

Any severe injury is accompanied by symptoms of shock The severity of these symptoms depends partly on the degree of sensory nerve stimulation at the time of the accident, but to an even greater extent on the loss of blood that has taken place

The effects of shock are two-fold, i e immediate and remote

**IMMEDIATE EFFECTS** Increase in pulse rate, general collapse, unconsciousness

**REMOTE EFFECTS** When the patient recovers from the immediate effects he is frequently left with the remote effects, which may be nervousness, sleeplessness, loss of appetite, tremors of the hands and increase in the pulse rate

These effects may persist after recovery from the local effects of the injury, and although in most cases they gradually disappear, in others they imperceptibly merge into a condition of traumatic neurasthenia (*q v*)

### APPROXIMATE DURATION OF DISABLEMENT

In dealing with claims, it is useful to have at least some idea as to the normal duration of disablement from the commonest injuries, and the following are the approximate durations.

## DISLOCATION—

	<i>Light Work</i>	<i>Heavy Manual Work</i>
Fingers	14 days	21 days
Wrist	21 "	28-56 "
Elbow, ulna or radius	21-28 "	28-56 "
Shoulder	21-28 "	28-56 "
Ankle	21-28 "	28-56 "
Knee	28-42 "	56-112 "
Knee cap	14-21 "	21-42 "
Hip	21-35 "	35-70 "

## FRACTURE—

	<i>Light Work</i>	<i>Heavy Manual Work</i>
Bones of hand	5-6 weeks	8-12 weeks
Forearm, one bone	6-8 "	8-12 "
Forearm, both bones	6-8 "	8-16 "
Upper arm	6-8 "	10-16 "
Collar bone	3-4 "	6-10 "
Shoulder blade	3-4 "	6-10 "
Lower jaw	4-6 "	8-12 "
Bones of foot	8-10 "	10-16 "
Leg (below knee)	8-10 "	12-24 "
Thigh	10-12 "	12-24 "
Knee cap	4-6 "	8-12 "
Pelvis	8-10 "	12-24 "

## AMPUTATIONS

Normal healthy stump can be used for suitable work at approximate dates following amputation as follows—

Finger or thumb	3 weeks
Toes	3-4 "
Arm	4-8 "
Leg, below knee	6-10 "
Thigh	12-24 "

## SPRAIN—

	<i>Light Work</i>	<i>Heavy Work</i>
Wrist	1-2 weeks	2-4 weeks
Elbow	1-2 "	2-4 "
Shoulder	1-2 "	2-4 "
Ankle	2-3 "	4-6 "
Knee	2-3 "	4-6 "
Hip	2-3 "	4-6 "

## HERNIA—

Date from operation	6 weeks	3 months
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If satisfactory truss can be fitted, patient can resume any ordinary work at once

## CHAPTER XXXIV

### INJURIES AND DISEASES OF BONES AND JOINTS

(For Fractures and Dislocations see Chapter XXXIII)

DISEASES of bones and joints are so closely allied that they are usefully grouped together

They may be acute or chronic, and may be local, i.e. may be confined to one joint or bone, or general, i.e. several bones or joints may be affected, and the joint or bone manifestations may be merely a part of a general constitutional disease. For this reason care in examination of these cases is of the greatest importance, as otherwise a disability may be attributed to some local condition, e.g. injury, whereas there may be some general constitutional disturbance to account for it.

Chronic diseases of bones and joints are so insidious in their onset and so intractable to treatment, that disability due to them may be indefinitely prolonged, and recurrence is extremely likely.

Most of the ordinary diseases of bones and joints are inflammatory (either acute or chronic) and are usually accompanied in the chronic cases by deformity of the bone or joint, owing to destruction of bone or cartilage in some places, and overgrowth or thickening in others. In Osteo-arthritis (*q.v.*), for example, there is frequently wearing away of the articular cartilage, so that the bone underlying it may be exposed, giving rise to a grating in the joint on movement, and at the same time the edges of the articular surfaces may develop bony thickenings and outgrowths (called Osteophytes) which still further hamper normal movements.

Such changes as these are permanent and, although the symptoms may be alleviated, the disability rarely disappears for more than short periods at a time, and then recurs.

#### **Relation of Injury to Bone and Joint Diseases.**

This is referred to elsewhere (*vide* pp 303, 335, 370). The importance and difficulty of this question from the point of view of an employer and employee can hardly be overestimated.

## TECHNICAL TERMS

Before describing the diseases of joints and bones individually, it might be useful to give the meanings of some of the expressions most commonly used in these cases

*Arthritis* Literally inflammation of a joint, it is applied as a general expression to designate changes in a joint due to inflammation or injury. It should be applied to a joint only if all the structures of a joint are affected, but is frequently loosely applied where the exact extent of the changes is not known

*Synovitis* Inflammation of the synovial membrane, whether due to infection by organism or to injury. Any joint in which there is abnormal thickening of the synovial membrane is usually described as being affected by synovitis

*Osteo-arthritis* Inflammation of the joint and adjacent bone (underlying the articular cartilage)

*Osteitis* Inflammation of bone

*Osteo-Myelitis* Inflammation of bone and bone marrow

*Myelitis* Inflammation of marrow of bone

*Ankylosis* Fixation of a joint by fibrous adhesions between the articular surfaces (fibrous ankylosis) or by bony union between the bones forming the joint (bony ankylosis)

## DISEASES OF BONES

Apart from deformities due to rickets and other general diseases, the commonest diseases of bone are either inflammatory or due to growths

## INFLAMMATORY DISEASES OF BONES.

Any of the three normal parts of a bone may be the seat of inflammation, i.e. the marrow (myelitis), the hard bone (osteitis), and the fibrous periosteal covering (periostitis). If the ends of the bone are primarily affected, it is termed *epiphysitis*

Of these epiphysitis and periostitis are the only conditions likely to occur by themselves

In other words, if the medulla of the bone is affected, the hard bone rarely escapes, the combined inflammation being known as osteo-myelitis

## Epiphysitis.

This is an osteitis of the end (epiphysis) of a long bone

CAUSE. Syphilis or tubercle are the commonest causes Injury may act as an exciting or aggravating cause in cases of tubercle

SYMPTOMS Pain and swelling of the epiphysis Limitation of movement of the neighbouring joint

In acute cases, rise of temperature In chronic cases, wasting of limb muscles

See also *Diseases of Joints* and *Tuberculosis*.

In syphilitic cases, a positive Wassermann reaction of the blood will be present.

COMPLICATIONS See *Syphilis*, *Tubercle*, *Diseases of Joints*

DURATION Dependent on cause and presence or absence of complications. In simple cases, three to twelve months.

## Osteomyelitis.

Inflammation of a bone, including the medulla

May be acute or chronic

The *Acute Form* is due to infection, which may be conveyed by the blood stream or reach the bone through a penetrating wound, from septic organisms Bruising, or even strain of the bone from injury, may be a predisposing cause (See *Inflammation*, p 362) It is a very serious condition and proves fatal in many cases

SYMPTOMS Intense pain in the bone, redness and swelling of the overlying tissues Marked increase in temperature and pulse Delirium may be present

COMPLICATIONS. Septicaemia (*q v*) The acute form may become chronic

DURATION Usually fatal within two or three weeks, unless the bone is drained by operation Incapacity from this operation may last two to six months, or may, in severe cases, if much destruction of bone has occurred, be permanent.

The *Chronic Form* may follow the acute form. Otherwise may be caused by a septic organism of low virulence, or to tubercle or syphilis If due to infection by septic organisms, large or small portions of the shaft of the bone may be killed and become slowly separated from the living bone Such a piece of dead bone is called a "Sequestrum."

*Necrosis* is the term applied to this process of destruction of bone *en masse*

The congested periosteum frequently lays down new bone which forms a sheath round the sequestrum. This sheath is called the *Involucrum*. Pus is formed within the bone during this process, and if not drained away by operation sets up pyaemia or septicaemia.

In tubercular conditions, the process is usually very slow, and a central abscess may be found in the bone, death of the bone occurring slowly, cell by cell, the bone appearing roughened and worm-eaten if examined.

Such a mode of bone destruction is called "Caries". The process is continued indefinitely until the whole bone becomes diseased, or the disease spreads to the neighbouring joint, unless the diseased portion is removed by operation.

**SYMPTOMS** Persistent pain in the bone, accompanied by swelling and, in septic cases, by thickening of the bone itself. A variable increase in temperature. Sinuses leading down to the centre of the bone and discharging pus may be present.

**COMPLICATIONS** Pyaemia, septicaemia, involvement of joints.

**DURATION** Indefinite. Operation is essential in most cases and incapacity may last six to twelve months or even longer. It may be permanent.

### Periostitis.

Inflammation of the periosteum.

**CAUSE** May be due to injury, tubercle or syphilis. It may be a complication of chronic ulcers over the tibiae. Injury may cause the condition, either by a wound conveying organisms, or by bruising, organisms being then deposited from the blood stream.

**SYMPTOMS** Pain and swelling over the part of the bone where the periosteum is affected. In acute cases redness and extreme tenderness are present.

**COMPLICATIONS** Phlebitis, abscess formation leading to death by necrosis of the underlying portion of bone.

**DURATION** In simple traumatic cases, three to six weeks. In complicated cases, and in tubercle and syphilis, the duration is indefinite. If mild, the condition is not necessarily incapacitating. Tuberculous cases may prove very intractable. In all cases except



syphilitic, operation may be necessary to remove the diseased tissues, if these do not react to other treatment.

## GROWTHS OF BONE

### Exostosis.

A local overgrowth of bone

**CAUSE** Unknown, but is attributed in some cases to an irregularity of the epiphyseal cartilage, part of which becomes separated from the main layer of cartilage, and by the formation of bone from this isolated piece, a bony projection from the side of the bone is produced

Injury may cause such an irregular growth to occur, or may cause a condition almost identical with an exostosis by tearing away the periosteum of the bone and with it bone-forming cells, which may then continue to grow and produce a bony growth projecting away from the main shaft of the bone

Persistent local irritation may produce the same effect

**VARIETIES** These are two in number, Ivory and Cancellous. These names describe the nature of the bone causing the tumour.

*Ivory Exostoses* are formed of dense bone of the consistence of ivory, and these are practically never met with except on the bones of the face or skull.

*Cancellous Exostoses* are formed of ordinary bone and are usually found towards the ends of long bones. A common situation is at the lower end of the femur on the inner side.

Such an exostosis in this position is sometimes termed "Rider's bone," as it is not uncommonly met with in horse riders, and has been attributed to the constant pull of the muscles attached to the femur on the inner side, in order to enable the horseman to grip with his knees. The constant pressure on the inner side of the knee in these men is probably a contributory cause

**SYMPTOMS** These are all due to the pressure exerted by the bony growth on surrounding parts, e.g. there may be neuralgic pains due to direct pressure on a nerve, weakness of certain movements owing to interference, by the growth, in the proper movements of tendons or muscles, or an interference in the range of movement of a joint owing to the projecting exostosis preventing free movement.

Exostoses may occur in the auditory canal, causing earache and deafness, or in the orbital cavity, causing an interference with vision or even blindness

SEQUELAE Nil

DURATION These symptoms will persist until the exostosis is removed by operation After operation disability may last for two to three weeks Recurrence may occur if the cartilage at the base of the exostosis is not completely removed

Ivory exostoses are probably never caused by injury, and it may be impossible to remove this variety owing to the hardness of the bone

**Osteoma.** (See *Exostosis* )

**Chondroma or Ecchondroma.**

A tumour formed of cartilage arising usually in the neighbourhood of the ends of the long bones (Epiphyseal cartilage)

CAUSE Unknown, but they may follow injury

SYMPTOMS, etc , are similar to those of exostosis

**Sarcoma** (See *Tumours* )

There are two varieties of this malignant growth—

(a) Endosteal, i e growing within the bone

(b) Periosteal, i e growing from the periosteum

(a) *Endosteal Sarcoma*

CAUSE Unknown, but there is no doubt that they may be caused by injury such as a fracture, as many cases are recorded of such growths arising at the site of a fracture

SYMPTOMS Pain and swelling of the bone, the usual situation of the growth being near a joint , weakness and limitation of movement of the joint

COMPLICATIONS The bone may fracture at the site of the growth (one cause of the so-called Spontaneous fracture) The growth may extend to the joint

DURATION Indefinite There are two varieties of these growths, one of which (Myeloid sarcoma) is comparatively slow growing in many cases, and does not give rise to secondary deposits Incapacity will be permanent in these cases unless the tumour is removed,

and even then the destruction of bone is commonly great enough to cause permanent partial disability

The other, "Malignant Endosteal sarcoma," is very rapid in its growth, and is usually fatal within a few months

(b) *Periosteal Sarcoma*

CAUSE Unknown

SYMPTOMS Pain, swelling and weakness of the limb, followed by wasting of the body, cachexia, and death.

COMPLICATIONS Those due to secondary deposits, which may occur anywhere in the body

DURATION Usually fatal within a few months Amputation is the only hope, and thus a very slender one, of recovery

## DISEASES OF JOINTS

### Arthritis.

CAUSE Inflammation of a joint may be caused by a very large number of diseases, and this heading is, therefore, sub-divided into the following—

*Acute Rheumatic* (See *Rheumatic Fever*)

*Rheumatoid Arthritis* An inflammatory condition of the joints (multiple), particularly of the small joints of the fingers, although any joints may be affected May be acute in its onset, but is often chronic in its course

CAUSE Usually attributed to a toxin circulating in the blood, produced either by a microbe from some possibly trivial infected spot, e.g. bad teeth, boils, etc., or derived by absorption from the alimentary canal, e.g. the large bowel

SYMPTOMS Frequently sudden in onset, when the joints become swollen and painful, especially on movement Many joints are affected, particularly the small joints of the fingers. There is not, as a rule, free fluid in the joints

The condition may clear up fairly quickly if the source of infection is removed, but otherwise the joints become permanently enlarged and stiff, frequently in very crippling positions

Rheumatoid arthritis cannot be caused by injury, although it may be aggravated thereby

**SEQUELAE** Deformities resulting from fixation of the joints  
May be followed by Osteo-arthritis

**DURATION** Indefinite

### **Osteo-Arthritis.**

A chronic disease of joints associated with the destruction of the articular cartilage and the outgrowth of bony prominences (Osteophytes) round the circumference of the joints

**CAUSE** Although it is possible for the disease to be caused by a microbic infection, it is commonly merely the result of old age and "wear and tear" of the joints. It must be remembered that every time a joint is moved some slight technical injury is caused to the articular surfaces, such injury being repaired at once. If, however, for any reason the power of repair is lessened, e.g. in patients suffering from constitutional diseases or in old age, such repair may not be completed before the joint is subjected to further "wear and tear". By a cumulative effect, therefore, mere use of the joint may result in osteo-arthritis.

*Injury as a Cause* From the above it is perfectly clear that one serious injury or strain of a joint may be sufficient to start the condition of osteo-arthritis, particularly in elderly subjects. On the other hand, the disease may already be present, and in that case, if symptoms develop only after the injury, this may have to be regarded as an aggravating cause. It must not, however, be assumed that this is so, as of course it is to be expected that osteo-arthritis, if present, will cause symptoms sooner or later, and it may be a mere coincidence that the symptoms make their appearance at or soon after the date of an alleged accident.

All these cases require the most careful investigation before an answer can be given to the question of whether an injury has any relation to the disability. In this connection it must also be borne in mind that some trivial injury, giving rise to a transient increase in symptoms in a joint, may so attract the attention of the patient to the joint that he subconsciously, or even consciously, exaggerates the slight pain that may persist, and which may, in fact, be no worse than it was before the accident.

**SYMPTOMS** One or more joints may be affected (usually several), pain and creaking or grating on movement of the joint, a feeling

of stiffness after the joint has been kept in one position, "lipping" of the edges of the articular cartilage, i.e. irregular thickening of cartilage and bone round the circumference of the articular surfaces. Definite osteophytes may be felt or seen by X-ray examination.

SEQUELAE Nil, apart from irremediable stiffness of the joints

DURATION. Indefinite

### Suppurative Arthritis.

An inflammation of a joint which becomes filled with pus.

CAUSE Infection by septic organisms. Sometimes follows specific infective fevers, e.g. scarlet fever, typhoid, etc., gonorrhoea. The infection may be due to

(i) A perforating wound of the joint whereby septic organisms are carried into it.

(ii) Spread of infection from disease of the bone in its neighbourhood (osteomyelitis)

(iii) Organisms being deposited in the joint from the blood stream, either in cases of pyaemia, when the patient is suffering from general blood poisoning, in which case several joints are frequently affected, or in cases where the patient may have no symptoms due to such organisms until they start to grow in the joint. In these cases a small septic focus anywhere in the body may be the primary source of infection

(iv) Gonorrhoeal. This is a not uncommon cause and should be suspected in all cases of doubtful origin

*Injury and Suppurative Arthritis* Apart from penetrating wounds, injury may play an important and indisputable part in the production of suppurative arthritis. It does so in those cases where a patient, apparently perfectly healthy, develops the condition immediately after an injury, such as a severe twist or strain of the joint

In these cases, what probably occurs is that the injury causes slight bruising, or effusion of blood into the structures near the joint, and in this stagnating blood some organisms become deposited from the circulation, and start to grow and so infect the joint. For a suppurative arthritis to be reasonably attributed to such a cause, it must make its appearance within a few days of the injury (at most ten to fourteen days).

**SYMPTOMS** Acute pain, swelling and redness of the joint; immobility on account of the pain, high temperature and pulse rate

**SEQUELAE** Septicaemia, pyaemia, and death may follow. Frequently the joint is completely destroyed and ankylosis, bony or fibrous, results. The limb may have to be amputated.

**DURATION.** Two to three months, and is frequently followed by permanent loss of use of the joint

**Tuberculous.** (See p 207)

### **Arthritis Deformans.**

A term sometimes applied to either rheumatoid or osteo-arthritis (*qv*)

### **Gonorrhoeal Arthritis.**

**CAUSE** Infection by the gonococcus (See *Gonorrhoea*)

**SYMPTOMS** Acute pain and swelling of one or more joints. There is tenseness of the skin and marked signs of inflammation. History or signs of urethral discharge may be present, but the joints may become infected after the urethral signs have disappeared, although in these cases the prostatic fluid will frequently be found to contain the gonococci.

The joint becomes distended with fluid, usually purulent. Opening the joint and draining it may be necessary, though the condition may subside without operation. Local treatment of the Urethra is essential.

**SEQUELAE** Stiffness and ankylosis of the affected joints may follow, pyaemia and septicaemia (See *Sequelae of Gonorrhoea*)

**DURATION** Three weeks to six or eight months. Partial permanent disability often follows.

### **Gout.**

**CAUSE** Excessive uric acid formation and deficient excretion.

**SYMPTOMS** Although gout is placed under the heading of arthritis, it is a disease of metabolism, i.e. is due to some error in the normal processes of digestion, absorption, and excretion of certain types of food, i.e. proteins which are rich in uric acid. All

parts of the body may be affected. Common symptoms are dyspepsia, eczema, cystitis. Iritis may occur, and in acute attacks increase of temperature associated with the joint symptoms.

*Joint Symptoms* These are characterized by paroxysmal attacks of intense shooting pains in the joints, with redness and swelling of these, and intolerance of any pressure. There is sometimes a visible deposit of uric acid in the skin near the joints or elsewhere, e.g. in the lobe of the ear. Such hard nodules are called "Tophi". The commonest joint to be affected is the metatarsophalangeal joint of the great toe.

*SEQUELAE* Suppuration may occur owing to the breaking of the skin due to deposit of uric acid crystals. Skin diseases, e.g. eczema, urticaria, are not uncommon, sciatica, lumbago and neuralgia, iritis.

*DURATION* Acute attacks last seven to twenty-one days, but persistent chronic pain may continue indefinitely and disable a man from heavy manual work.

### Arthritis Following Specific Fevers.

Arthritis is a complication or sequela of many specific fevers of which, perhaps, the commonest are scarlet fever, typhoid, and dysentery. The symptoms, complications and duration are similar to those of ordinary suppurative arthritis (*q v*).

### Syphilitic Joint Diseases.

Syphilis (*q v*) may affect joints either in its secondary or tertiary stage, and some joint diseases are so frequently associated with a history of syphilis in past years that they are regarded as para-syphilitic affections.

*Synovitis* A simple passing synovitis may occur in the secondary stage of syphilis. This synovitis is indistinguishable from a simple synovitis (*q v*).

*Arthritis* A general disease of the joints involving cartilage, bone and synovial membrane may occur in the later tertiary state of syphilis.

*SYMPTOMS* Swelling of the joints, especially of the synovial membrane, and grating in the joints on movement. Pain is very frequently absent, although in some varieties acute neuralgic pains may be present.

**SEQUELAE** The joint may be disorganized and flail-like so as to be almost useless

**DURATION** Indefinite There is a great tendency to recurrence

*Charcot's Disease* This is an extreme form of osteo-arthritis in which excessive destruction of the surfaces of the joint occurs, and in some cases the neighbouring bone overgrows to a marked extent, so as to give rise to a mushroom-like appearance of the end of the bone

**CAUSE** It is usually associated with signs of tabes dorsalis (*q v*), and may therefore be regarded as indirectly caused by syphilis

**SYMPTOMS** Increasing swelling and weakness of the joint The onset may be associated with sharp "lightning" pains in the joints

**SEQUELA** Complete loss of use of the joint

**DURATION** The disease is progressive and the duration therefore indefinite

### Synovitis.

An inflammation of the synovial membrane of the joint usually associated with an effusion of fluid into the joint

**CAUSE** A synovitis may be due to an extension to the synovial membrane of neighbouring infection, or disease, such as chronic rheumatism, syphilis, tubercle, but there are a large number of cases in which a simple synovitis follows injury, slight or severe, especially if the joint is strained or wrenched, and another group occurs in which no history or possible cause can be found These are called cases of "idiopathic" synovitis

*Accidents and Synovitis* There is no doubt that synovitis may be caused by injury, and the injury may be very slight, e.g. a man may jar his knee or ankle by stepping heavily off a step, and this may be followed at once by a synovitis of the joint Synovitis, if it is to be attributed to such an injury, must follow the injury within two or three days, the only exception being that a joint so jarred may be not sufficiently injured to cause a synovitis unless recovery is prevented by the joint being kept in use In such a case there will be a continuous history of increasing pain and stiffness, and perhaps one to two weeks later a definite synovitis may develop

It may be said that, generally speaking, if there is any immediate



history of injury preceding the synovitis, the two cannot be disconnected

**SYMPTOMS** Synovitis may be acute or chronic

*Acute* Feeling of tenseness and pain in the joint, swelling and immobility of the joint, which is usually kept partially flexed

*Chronic* The pain is less marked than in the acute type. The synovial membrane is usually more thickened and, frequently, a very fine grating can be felt on movement. The joint becomes painful if allowed to remain long in one position

**SEQUELAE** The acute form may be followed by the chronic. In chronic cases the joint may become permanently stiff and limited in movement, owing to persistence of the thickening of the synovial membrane

**DURATION** *Acute* One to three weeks

*Chronic* Indefinite. Symptoms may subside completely after prolonged treatment, but recurrence is the rule

### Sacro-Iliac Disease.

**CAUSE** Tubercle is by far the commonest cause. Injury frequently plays an important part in determining the onset of the disease, and the relation of injury to the disease is the same as in the case of tubercle of other joints. (See *Effect of Injuries on Tubercular Conditions*, p 209)

**SYMPTOMS** Pain in the lower part of the back near the joint, sciatica, limping

**DURATION** The condition is very intractable, and needs either prolonged treatment in splints extending over six or eight months at least, followed by restricted use of the legs for another six months, or treatment by operation, when the period of disability is at least as great, and in some cases is permanent as far as heavy work is concerned, owing to the weakening of the joint due to the operation and disease

**SEQUELAE** Abscess formation, permanent weakness of the back, Pyaemia, lardaceous disease

### Tuberculous Disease of the Spine (Pott's Disease)

**CAUSE** The tubercle bacillus. Injury may excite or aggravate the condition. (See *Effect of Injuries on Tubercular Conditions*, p 209)

**SYMPTOMS** Pain in back, sharp and shooting at times, the patient gets easily tired, general weakness and loss of vitality, deformity of the spine (angular curvature) Paralysis may be present owing to pressure on the spinal cord, but this is rare

**DURATION** Indefinite The disease may be arrested permanently by prolonged treatment extending over months or years, but there is a strong tendency towards recurrence, particularly following injury

**SEQUELAE** Permanent deformity of spine, abscess formation (Psoas abscess, so called owing to the abscess usually passing down this muscle within the abdomen The formation of such an abscess prolongs recovery indefinitely); lardaceous disease

### **Coccydynia (Painful Coccyx)**

**CAUSE** May be due to periostitis (*qv*) of the Coccyx, but usually follows injury, in which the bone has been badly bruised, especially if any displacement has occurred

**SYMPTOMS** Pain on sitting or stooping or walking; extreme pain on touching the coccyx may be present

**COMPLICATIONS** Neurasthenia is a not uncommon sequela

**DURATION** The condition is extremely intractable, and disability may be total for many weeks or even months It may be necessary to remove the bone

### **Mallet Finger.**

A condition in which the terminal phalanx is flexed to a right angle and cannot be straightened It is due to injury to the extensor tendon on the back of the joint

It is disabling in that the finger gets in the way, and treatment is very difficult Operation by sewing the tendon to the covering of the bone is sometimes successful, but by no means always Amputation may have to be performed

### **Metatarsalgia.**

Pain under and between the heads of the metatarsal bones

**CAUSE** Abnormal pressure on the nerves by the heads of adjacent bones, which may, on account of injury or continuous strain, be in abnormally close contact

Normally there is a slight arch running across the foot under the heads of the metatarsals, the middle bones being a little higher in position than the outer ones. If this arch is flattened out, the heads of the middle bones press abnormally hard on the ground and also against each other.

**SYMPTOMS** Constant pain in the fore part of the foot as soon as weight is put upon it. Limping and incapacity result. The treatment consists in raising the flattened arch by wearing a support in the fore part of the boot. In time the bones may become re-established in correct position and the symptoms cease.

The condition is, however, very intractable, and may give rise to incapacity for long periods.

**DURATION** Indefinite

## Rheumatism.

This may occur in two forms—

1. Muscular (Myalgia)
2. In joints (Rheumatic arthritis)

### 1 *Myalgia*

**CAUSE** Usually cold or exposure. It is particularly liable to attack those so exposed after, or during, heavy work.

**SYMPTOMS** Acute neuralgic pains in the muscles affected, particularly during their contraction, or if they are placed in certain positions, or put on the stretch. Lumbago and torticollis (wry-neck) are common examples.

**COMPLICATIONS** Nil

**DURATION** One to ten weeks or more

### 2 *Rheumatic Arthritis*

(See *Rheumatic Fever* and *Rheumatoid Arthritis*)

## Chronic Rheumatism.

Pains of a rheumatic character occurring in the joints, chiefly in elderly people.

**CAUSE** Usually due to cold or exposure, especially if associated with heavy laborious work.

**SYMPTOMS.** Pain and stiffness in the affected joints. Such pain may be referred to the muscles overlying the joints, movement is

painful, pain is worse in damp weather. The synovial membranes may be thickened and a fine grating felt in the joint on movement.

**COMPLICATIONS** Stiffness may become almost complete, resulting in a pseudo-ankylosis.

**DURATION** Indefinite. Tends to become progressively worse.

### Loose Bodies in Joints.

**CAUSE** 1 In tuberculous disease a fibrinous exudation may occur, and flattened bodies, so-called "Melon seeds," may be produced.

2 Portions of cartilage may be torn away from the ends of the bones or separated from the intra-articular cartilage, e.g. the semilunar cartilage of the knee.

3 Small pieces of bony outgrowths in cases of chronic osteo-arthritis (Osteophytes) may be broken off into a joint.

Injury plays no part in (1), but in (2) and (3) the condition is frequently brought about by a definite injury.

**SYMPTOMS** Pain and swelling (synovitis) of the joint. The pain may be intense if the foreign body gets nipped between the ends of the bones.

Locking of the joint, i.e. sudden fixation of the joint, may occur, and as quickly disappear owing to the movement of the loose body.

**COMPLICATIONS** Nil, apart from persistence of the symptoms. In cases in which osteo-arthritis has not been pre-existent, this condition may develop.

**DURATION** Until the loose body is removed. In some cases the loose body may get "tucked away" and give no trouble for long periods, but sooner or later it is bound to give rise to symptoms and disability.

Disability following operation in cases not complicated by osteo-arthritis, one to three months.

## CHAPTER XXXV

### INDUSTRIAL DISEASES

*List of Industrial Diseases included in Schedule III of the Act of 1906, as Extended by the Secretary of State's Orders, Dated 26th February, 1918-16th January, 1924.*

Description of Disease or Injury.	Description of Process.
1. Anthrax	Handling of wool, hair, bristles, hides and skins
2 Mercury poisoning or its sequelae.	Any process involving the use of mercury or its preparations or compounds.
3 Phosphorus poisoning or its sequelae	Any process involving the use of phosphorus, or its preparations or compounds
4 Arsenic poisoning or its sequelae	Handling of arsenic or its preparations or compounds
5 Lead poisoning or its sequelae.	Handling of lead or its preparations or compounds
6 (a) Poisoning by benzene and its homologues, or the sequelae	Handling benzene or any of its homologues, or any process in the manufacture or involving the use thereof
(b) Poisoning by nitro- and amido-derivatives of benzene and its homologues (trinitrotoluene, anilin, and others), or the sequelae	Handling any nitro- or amido-derivative of benzene or any of its homologues, or any process in the manufacture or involving the use thereof
7. Poisoning by dinitrophenol or its sequelae	Handling dinitrophenol, or any process in the manufacture or involving the use thereof

Description of Disease or Injury.	Description of Process.
8 Poisoning by nitrous fumes or its sequelae	Any process in which nitrous fumes are evolved
9 Dope poisoning; that is, poisoning by any substance used as or in conjunction with the solvent for acetate of cellulose, or its sequelae	Any process in the manufacture of aircraft
10 Poisoning by tetrachlorethane or its sequelae	Any process in the manufacture or involving the use of tetrachlorethane
11 Poisoning by carbon bisulphide or its sequelae	Any process involving the use of carbon bisulphide, or its preparations or compounds
12 Poisoning by nickel carbonyl or its sequelae	Any process in which nickel carbonyl gas is evolved
13 Poisoning by Gonioma Kamassi (African boxwood) or its sequelae	Any process in the manufacture of articles from Gonioma Kamassi (African boxwood)
14 Manganese poisoning	Handling of manganese or substances containing manganese
15 (a) Dermatitis produced by dust or liquids	—
(b) Ulceration of the skin produced by dust or liquids	—
(c) Ulceration of the mucous membrane of the nose or mouth produced by dust	—
16 (a) Epitheliomatous cancer or ulceration of the skin due to tar, pitch, bitumen, mineral oil or paraffin, or any compound, product, or residue of any of these substances	Handling or use of tar, pitch, bitumen, mineral oil or paraffin, or any compound, product, or residue of any of these substances

### Description of Disease or Injury.

### Description of Process.

- |   |   |
|---|---|
| <p>(b) Ulceration of the corneal surface of the eye, due to tar, pitch, bitumen, mineral oil or paraffin, or any compound, product, or residue of any of these substances</p> | <p>Handling or use of tar, pitch, bitumen, mineral oil or paraffin, or any compound, product, or residue of any of these substances</p> |
| <p>17 Chrome ulceration or its sequelae.</p>  | <p>Any process involving the use of chromic acid or bi-chromate of ammonium, potassium, or sodium, or their preparation</p>             |
| <p>18 Scrotal epithelioma (chimney sweep's cancer)</p>  | <p>Chimney sweeping</p>   |
| <p>19 Compressed air illness or its sequelae</p>  | <p>Any process carried on in compressed air</p>   |
| <p>20 Cataract in glass workers <sup>1</sup></p>  | <p>Processes in the manufacture of glass involving exposure to the glare of molten glass</p>  |
| <p>21 Cataract caused by exposure to rays from molten or red-hot metal</p>  | <p>Processes normally involving such exposure in the manufacture of iron or steel</p>   |
| <p>22 Ankylostomiasis</p>   | <p>Mining.</p>  |
| <p>23 The disease known as Miner's Nystagmus, whether occurring in miners or others, and whether the symptoms of oscillation of the eyeballs be present or not</p>            | <p>Mining.</p>  |
| <p>24 Subcutaneous cellulitis of the hand (beat hand).</p>  | <p>Mining</p>   |
| <p>25 Subcutaneous cellulitis over the patella (miner's beat knee)</p>  | <p>Mining.</p>  |

<sup>1</sup> Employers are not liable for the payment of compensation for more than six months

Description of Disease or Injury.	Description of Process.
26 Acute bursitis over the elbow (miner's bent elbow).	Mining
27 Inflammation of the synovial lining of the wrist joint and tendon sheaths	Mining
28 Glanders	Care of any equine animal suffering from glanders ; handling the carcass of such animal.
29 Telegraphist's cramp <sup>1</sup>	Use of telegraphic instruments
30 Writer's cramp <sup>1</sup>	—
31 Twister's cramp caused by twisting of cotton or wool-len (including worsted) yarns <sup>2</sup>	—
32 Inflammation, ulceration, and malignant disease of the skin and subcutaneous tissues, due to exposure to X-rays or radio-active substances	—

*Industrial Diseases included in Schedule III of the Act of 1906,  
as Extended by the Secretary of State's Orders, Dated 26th  
February, 1918—16th January, 1924*

### Anthrax.

The entry of an organism, known as the *Bacillus Anthracis*, into the skin, usually transferred from the hides of hair of animals who have been infected with the disease, which is common among foreign animals. The bacillus is very resistant, and its spores can live inert a long time and subsequently develop under favourable circumstances

<sup>1</sup> Employers are not liable for the payment of compensation for more than twelve months

<sup>2</sup> Employers are not liable for the payment of compensation for more than six months



**SYMPTOMS** The disease occurs in two forms—

1 *External Anthrax* (Malignant Pustule) Inoculation usually occurs on the head, neck, and arms, i.e. where the skin is exposed. Within a few hours of infection a small "pimple" appears and the surrounding tissues become angry and red and hard. The centre then becomes dark brown or black in colour and all the neighbouring parts become swollen. Infection of the neighbouring lymph glands occurs.

**DURATION** Three to ten days, when death supervenes unless the pustule is excised and strong antiseptics, e.g. mercury or carbolic acid, are applied.

## 2 *Internal Anthrax*—

### (a) *Intestinal*

**SYMPTOMS** Initial chill, vomiting, diarrhoea, fever, and general pains, enlargement of spleen.

**DURATION** Two to fourteen days.

(b) *General Infection* Wool Sorters' disease. Caused by the inhalation of anthrax bacilli from wool and hair during sorting and cleaning. Skins from Russia are most dangerous.

**SYMPTOMS** Initial chill, prostration, general pains, cough and rapid breathing, high temperature and rapid pulse.

**DURATION** Three to fourteen days. Usually fatal.

**TREATMENT** In malignant pustule this should be excised and carbolic acid or mercuric chloride injected in the surrounding tissues to prevent the growth of organisms there. An anti-anthrax serum is sometimes successful.

**SEQUELAE** Nil, except deformity due to scarring.

## **Mercury Poisoning.**

**OCCUPATIONS** Furriers, gold and silver mining, gilders, felt hat makers, mining and smelting of mercury ore, mirror plating; thermometer and barometer making, electric-bulb making.

**SYMPTOMS** Softening of and bleeding from the gums, increased salivation, anaemia, tremors of the hands and legs, giddiness and headache.

**SEQUELAE** Nephritis, paralysis, lung disease is not uncommon.

**DURATION** After removal from contact with the metal or its fumes, one to six months

### Phosphorus Poisoning.

**OCCUPATIONS** Match-making

**SYMPTOMS** Vomiting and gastric pain, haemorrhage from mucous membrane and from stomach, cardiac weakness or failure, jaundice, delirium, enlargement of the liver, development of abscesses in the jaw with softening of the bones of the jaw, so-called "Phossy-jaw"

**SEQUELAE** Persistent cardiac weakness and dyspepsia

**DURATION** May prove fatal in from one to twenty-one days  
If not fatal, the symptoms may persist some months The "Phossy-jaw" is particularly intractable

### Arsenic Poisoning.

**OCCUPATIONS** Ore smelting, dyeing, glass workers; insecticide manufacture, tanning, bronzing, workers in furs and skins where arsenic is used as a preservative

**SYMPTOMS** *Acute* Nausea, vomiting, diarrhoea, tenesmus, abdominal pain and colic, severe thirst, cramp in legs, cardiac failure

*Chronic* Dyspepsia, gastro-intestinal symptoms of vomiting, diarrhoea and pain, neuritis, oedema of the eyelids and conjunctiva may occur, paralysis of muscles, particularly of the lower limbs.

**SEQUELAE** Neuritis and partial muscular paralysis may persist

**DURATION** *Acute* One to seven days

*Chronic* Several months

### Lead Poisoning.

**OCCUPATIONS** Manufacture of red lead (oxide), white lead (carbonate), painting, plumbing, shot manufacture, type founding, glass manufacture, glass polishing, dyeing, pottery glazing, tinplating, electric accumulator works, enamel and japanning workers

**SYMPTOMS** There are two means of entry of the poison into the system 1 Through the alimentary tract 2 By inhalation

The symptoms may be either chronic or acute

*Chronic* Abdominal colic, constipation, neuritis, dropped wrist, anaemia, general debility, vomiting, tremor, muscular wasting, "Blue line" along the margin of the gums is characteristic and is due to the deposit of sulphide of lead formed by the action of the tartar of the teeth on the lead circulating in the blood, abortion in women

*Acute* Severe abdominal pain, vomiting, pains in the limbs, collapse.

SEQUELAE Nephritis, optic atrophy, insanity and epilepsy, gout, arterio-sclerosis

DURATION *Acute* One to three weeks.

*Chronic* One to twelve months

### Poisoning by Benzene and Its Homologues.

OCCUPATIONS Distillation of petroleum (manufacture of petrol, benzene, naphtha), manufacture of rubber goods, dry cleaning, use of quick-drying paints

SYMPTOMS Very similar to alcohol intoxication, giddiness, nausea, vomiting, salivation, cough, there may be muscular twitching

SEQUELAE Apart from persistence of symptoms, no sequelae are likely to occur

DURATION Varying with severity, from one to thirteen or more weeks

### Poisoning by Nitro- and Amido-Benzene. (Homologues trinitrotoluene, anilin, etc)

OCCUPATIONS Manufacture of benzene and anilin from coal tar, dyeing

SYMPTOMS The poison may be absorbed either through the skin, by inhalation, or by the digestive system

The chronic symptoms are headache, giddiness, loss of power in the limbs, pallor; sometimes blindness

In chronic cases there may be anaemia, dyspepsia, cramp in the muscles, sleeplessness, eczema

SEQUELAE Apart from the persistence of symptoms mentioned above, no sequelae are likely to occur.

DURATION Indefinite.

**Poisoning by Dinitrophenol.**

OCCUPATIONS Dyeing, manufacture of anilin

SYMPTOMS These may be local of the skin, when the patient suffers from itching and eczematous eruptions, or more general constitutional symptoms, such as headache, nausea, and giddiness

SEQUELAE No sequelae apart from persistence of symptoms

DURATION Indefinite

**Poisoning by Nitrous Fumes.**

OCCUPATIONS Chemical manufacturing and transporting of nitric acid

SYMPTOMS These are chiefly of the respiratory organs, and consist of irritation of the mucous membrane of the nose, mouth, and bronchial tubes, bronchial catarrh, and in long-standing cases, anaemia

If the patient is subject to sudden exposure to concentrated fumes, there may be acute symptoms of suffocation, laboured respiration, lividity, oedema of the lungs and sometimes death

SEQUELAE Chronic bronchitis may persist

DURATION *Acute* One to three weeks

*Chronic* One to six months

**Dope Poisoning.**

OCCUPATIONS Manufacture of aeroplanes

Dope is the popular name given to any solution used for dissolving cellulose, the commonest of which is tetrachlorethane, which is used for painting the wings of aeroplanes

SYMPTOMS Abdominal pain, nausea, jaundice, headache  
It may prove fatal

SEQUELAE Chronic dyspepsia

DURATION One to six months

**Tetrachlorethane Poisoning. (See *Dope Poisoning*)****Carbon Bisulphide Poisoning.**

OCCUPATIONS. Manufacture of rubber goods, preparation of cellulose for artificial silk manufacture, dry cleaning

**SYMPTOMS** In mild cases there may be symptoms of intoxication, irritability and sleeplessness

In more severe cases pallor, headache, weakness of the arms and legs, drowsiness, nausea and vomiting

In more chronic cases there may be recurring attacks of excitement; headache, faintness and giddiness

**SEQUELAE** Cardiac weakness

**DURATION** *Acute* One to four weeks

*Chronic* One to six months

### **Nickel Carbonyl Poisoning.**

**OCCUPATION** Manufacture of the chemical

**SYMPTOMS** In mild cases headache, giddiness; nausea and dyspepsia

In acute cases there is marked dyspnoea, blueness of the skin, acute congestion of the lungs. It may be fatal

**SEQUELAE** Chronic dyspepsia may persist for many months

**DURATION** One to six weeks.

### **Poisoning by Gonioma Kamassi (African boxwood)**

**OCCUPATION** Workers using the wood, which is used for making shuttles for weaving

**SYMPTOMS** Those of cardiac asthma, shortness of breath and palpitation

**SEQUELAE** In severe cases cardiac weakness may persist indefinitely

**DURATION** Three to twelve weeks

### **Manganese Poisoning.**

**OCCUPATION** Manufacture of permanganate of potash and oxygen

**SYMPTOMS** These may be caused by inhalation or swallowing of manganese or its compounds. Symptoms are those of general muscular weakness with alteration of the mental condition, strongly resembling hysteria, tremors of the hands and tongue

**SEQUELAE** Nervous and mental weakness may persist

**DURATION** Indefinite

### Dermatitis, Produced by Dust or Liquids.

The above condition may be caused by contact with any irritating dust or liquid, although some of these are much more liable to produce bad effects than others

The commonest irritants producing these effects are flour, sugar, tar, spirit solvents used in french polishing, and similar liquids, e g mineral oils

The forms of dermatitis which can be produced in this way are various. They are usually irritating in character, and may spread from the site originally affected to other parts of the body. They resemble in many ways ordinary skin conditions such as eczema, but are usually in their early stages confined to the parts exposed to the irritant, and their distribution is frequently irregular. Ulceration of the skin is usually superficial but chronic in nature, and recovery is usually very prolonged. In some cases, particularly where tar is the cause, the ulcers may become cancerous (epithelioma)

It is impossible to describe in detail the many forms of skin trouble which may be produced by dust or liquids falling under this heading. In many cases it is impossible to distinguish such conditions from dermatitis caused in other ways, and very careful inquiry into the history and occupation of these cases is essential in order to safeguard the employers' interests

It should be noted that, contrary to what might be expected, a man may remain exposed to irritation from dust or liquids for many years and suffer no ill effects, and may then contract a dermatitis. The explanation of this is unknown. It is sometimes associated with the lowering of the general health, or may be due to a change of surroundings where efficient precautions are not used to protect the workers

When a patient has once suffered from dermatitis of this nature, it is extremely liable to recur, and in his own interests he should not be allowed to resume work involving contact with the irritating substance which was the cause of the original dermatitis

The period of disability caused by these complaints is usually prolonged, and in any case it is impossible to estimate with any accuracy. There is a great tendency for the skin to heal almost completely, and then to break down again as badly as before, even if the patient be not exposed to the irritant

Common occupations producing a dermatitis are baking, working with tar or asphalt, sugar manufacture, french polishing, and work involving contact with chemicals

### **Epitheliomatous Cancer and Ulceration of the Skin due to Tar, Pitch, Bitumen, Mineral Oil, or Paraffin.**

**OCCUPATIONS.** Workers who come in contact with the substances mentioned in the schedule

**SYMPTOMS** Ulceration of the exposed skin, usually of a chronic character Such ulceration, if allowed to continue without effective treatment, may become cancerous, when it is called an epitheliomatous cancer, and operative treatment is then required for its cure Such an epithelioma is, as a rule, slow growing, and if removed in the early stages, a cure can usually be effected.

It must, however, be recognized that the condition is cancerous and may, and frequently does sooner or later, produce secondary growths, which may cause the death of the patient

**SEQUELAE** Secondary growths may develop after the primary one has been removed These secondary growths may occur anywhere in the body

**DURATION** Epitheliomatous ulceration due to exposure to these irritants is incurable except by operation Disability resulting from the operation, unless the ulceration is very extensive, should not last more than three or four weeks

### **Ulceration of the Corneal Surface of the Eye.**

Ulceration of the cornea may occur in any of the occupations involving the use of tar, pitch, etc., as mentioned in the schedule, and is due to direct irritation of the eye by contact with the irritating substance Such ulceration may give rise to blindness owing to the scarring of the cornea, and does not differ from ulceration produced by any other means (See *Diseases of the Eye*)

**SEQUELAE** Blindness, iritis; general infection of the eye

**DURATION** It is often very intractable, and although in some cases recovery may take place in three to four weeks, as a rule it is a question of some months before the patient is able to use the eye if the ulceration is at all extensive

### Chrome Ulceration.

**OCCUPATIONS** Any occupation involving the use of chromic acid or bi-chromate of ammonium, potassium, or sodium, e g preparations of pigments and in chemical works

**SYMPTOMS** An eczematous dermatitis is liable to be caused by irritation from these compounds, and pursues a course similar to that of dermatitis due to other irritants (See *Dermatitis*)

A characteristic effect of this particular irritant is ulceration of the nasal mucous membrane, which may result in chronic nasal trouble, chronic discharge, etc

**SEQUELAE** Chronic rhinitis (*qv*) with nasal discharge

**DURATION** Indefinite

### Scrotal Epithelioma.

This is a cancerous ulceration or growth of the skin of the scrotum, due to irritation from soot It is very rarely seen nowadays, but was more common in the days when chimney sweepers ascended the chimneys

**SEQUELAE** Unless an early operation is carried out, secondary deposits in various parts of the body, particularly the abdomen, occur, and death is the result

**DURATION** After operation, from three weeks to three months If secondary deposits have occurred, disability will recur within a short time and be followed by death

### Compressed Air Illness (Caisson Disease)

**CAUSE** The sudden release of increased oxygen pressure in the tissues In diving operations the diving-bell or chamber (Caisson) has to be kept at a high atmospheric pressure, and on emerging from this too suddenly, the workman may be seized with symptoms of acute pain, caused probably by the sudden release of nitrogen from the blood that has been absorbed under the high pressure within the caisson

**SYMPTOMS** Acute pains in joints and muscles, vomiting, sometimes paralysis

**SEQUELAE** Paralysis of the limbs may persist indefinitely

**DURATION** Very variable A few days to many months The condition can be prevented by releasing the pressure in the caisson gradually



### Cataract in Glass-workers.

**OCCUPATIONS.** Glass-workers, due to exposure to the glare of molten glass

**SYMPTOMS** Gradual failure of vision accompanied by pain in the eye owing to the development of opacity in the lens (cataract)

**SEQUELAE** Nil

**DURATION** The condition may be prevented by the wearing of suitable glasses, but when once it has made an appearance it is progressive, and an operation for the removal of the lens is the only effective cure

Under the Workmen's Compensation Act the time during which compensation is to be paid is limited to six months, as it is generally regarded as being possible for most workers to recover after the operation sufficiently to resume work within that time

### Cataract from Exposure to Rays from Molten or Red-hot Metal.

The cause of this condition and the history is similar to that of glass-workers' cataract

There is, however, no specific time mentioned in the schedule for the time during which compensation is payable.

### Ankylostomiasis.

Caused by the entry of a worm of peculiar shape (the Hook-worm) into the intestines.

It is primarily a tropical or sub-tropical disease, affecting chiefly miners and tunnellers who work in close contact with damp soil. It is fairly common in some parts of Germany, and has been met with in England, chiefly among the Cornish miners (Boycott and Haldane)

The mode of entry of the embryo worm may be by the mouth or through the skin, by which means it enters the blood stream and so may affect the lungs, being conveyed there via the veins and right side of the heart

The adult worm is found only in the intestine and lives by sucking the blood from the mucous membrane of the bowel

**SYMPTOMS** Abdominal pain, gastro-intestinal irritation and increase of temperature. In prolonged cases the characteristic

feature is the anaemia caused by the abstraction of the blood. The number of red blood cells may be only half normal, whereas the white blood cells may be very much increased in number.

In late stages the liver and spleen may be enlarged. The eggs of the parasite are passed with the motions.

SEQUELAE Anaemia may persist indefinitely.

DURATION One to two weeks. In chronic cases, indefinite.

### Miner's Nystagmus.

OCCUPATION. Mining.

SYMPTOMS The characteristic symptom is rotatory and oscillating movements of the eyes, sometimes extending also to the head and neck. The eye movements are regular and not shaky, in this respect differing from a nystagmus caused by disease.

There is loss of acuity of vision, and neurasthenia is a frequent accompaniment. The cause is usually ascribed to dim illumination.

SEQUELAE Persistent neurasthenia.

DURATION Indefinite.

### Subcutaneous Cellulitis of the Hand (Beat Hand)

OCCUPATION. Mining.

SYMPTOMS A chronic thickening of the tissues underlying the skin of the palm of the hand, caused by irritation from handling tools, and associated with an extremely tender condition of the tissues. It is a form of inflammation and may result in the formation of pus.

SEQUELAE. Stiffness of fingers, and weakness of grip if suppuration has occurred.

DURATION Three to six weeks. In severe cases longer.

### Subcutaneous Cellulitis Over the Patella (Beat Knee)

OCCUPATION Mining.

SYMPTOMS Chronic inflammatory thickening of the skin of the front of the knee, which is tender. It is caused by persistent irritation owing to constant kneeling.

SEQUELAE Nil.

DURATION. Three to six weeks.

**Acute Bursitis Over the Elbow (Beat Elbow)**

OCCUPATION Mining

SYMPTOMS Swelling and pain of the bursa lying over the point of the elbow. This is due to constant pressure, due to the attitude of necessity adopted while at work It may be followed by suppuration.

SEQUELAE Nil

DURATION Three to six weeks

**Inflammation of the Synovial Lining of the Wrist Joint and Tendon Sheaths (Teno-synovitis)**

OCCUPATION. Mining

SYMPTOMS Pain and weakness in the affected joint and tendons and loss of power of grip There is fine grating felt over the tendon sheaths on bringing the tendons into play Tenderness along the course of the tendon and over the wrist joint

SEQUELAE Nil

DURATION Two to ten weeks

**Glanders.**

An infectious disease common in horses and occasionally communicated to man.

CAUSE It is due to a specific bacterium, the *Bacillus Mallei**Acute*

SYMPTOMS The characteristic feature is the development of nodules usually of the nose; increase of temperature The nodules in a few days break down into ulcers General infection occurs and a fatal result is invariable in the acute form

DURATION Seven to ten days.

*Chronic*

SYMPTOMS Chronic ulceration and discharge from the nose or larynx

DURATION Indefinite

Another variety of glanders due to infection of the skin by the same organism is known as "Farcy" It may be acute or chronic, and is characterized by nodules and ulcers developing in the skin, followed in acute cases by septicaemia and death. In chronic

cases the condition may last a long time Treatment of this form usually consists of excision of the ulcers and nodules

SEQUELAE Septicaemia, disability may develop from scarring

### **Telegraphist's Cramp.**

OCCUPATION Telegraph workers using Morse code

SYMPTOMS Spasm of the wrist muscles and pain preventing the raising and lowering of the hand on the keys

SEQUELAE Nil

DURATION Indefinite Under the Workmen's Compensation Act liability for payment of compensation is limited to twelve months.

### **Writer's Cramp.**

OCCUPATION Constant writing

SYMPTOMS Pain in the small muscles of the hand, tremor and weakness of the grip It is due to a functional affection of the nerves

SEQUELAE Nil

DURATION Three to six months Under the Workmen's Compensation Act liability for the payment of compensation does not extend beyond twelve months

### **Twister's Cramp.**

OCCUPATION Weaving.

SYMPTOMS Pain at the base of the thumb, and swelling of the small muscles of the thumb It is caused by constant and rapid twisting of threads when these have to be joined in the process of weaving

SEQUELAE Nil

DURATION One to three months Under Workmen's Compensation Act liability for the payment of compensation is limited to six months

### **Inflammation, Ulceration, and Malignant Disease of the Skin and Subcutaneous Tissues, Due to Exposure to X-Rays or Radio-active Substances.**

OCCUPATION Workers constantly exposed to X-ray emanations

SYMPTOMS The symptoms due to continued exposure to X-rays

are similar to those caused by exposure to any constant irritant, and resembles those found in ordinary cases of industrial dermatitis, but are usually much more severe. It is usually due to lack of care in the wearing of protecting clothing, such as lead gauntlets, etc.

**SEQUELAE.** Recurrence of dermatitis, malignant disease (cancer), anaemia

**DURATION** The condition is very intractable, and is likely to be followed by very serious results, e.g. development of cancer, unless exposure to the rays is stopped in the very early stages. It is liable to recur unless sufficient care is taken to prevent it.

### **Pneumonokoniosis.**

A chronic lung disease caused by inhalation of metallic dust or dust from rocks, coal, etc

A variety of names are given to this condition according to the nature of the dust, e.g. an Anthracosis (coal-miner's disease, caused by inhalation of coal dust), Silicosis, produced by inhalation of dust from stones or rocks (Stone-cutter's Phthisis)

**SYMPTOMS** Usually start after some years working under dusty conditions. Cough and shortness of breath are common. Expectoration of pus and mucus mixed may occur. Cavities may develop in the lung

**COMPLICATIONS** Chronic bronchitis, emphysema

**DURATION** Indefinite. The disease is chronic and although in early cases the patient may recover in the course of three to six months sufficiently to resume work, a return to his old work will inevitably cause a return of the symptoms

### **Zinc Poisoning.**

Workers in zinc, in smelting or mining may develop a neuritis (*qv*). Other symptoms have been described as being due to zinc, e.g. sensory disturbances in feet and legs, but the evidence that zinc is the cause and not some other constituent mineral of the ores (e.g. lead) is not clear

## CHAPTER XXXVI

HAEMORRHAGE   INFLAMMATION · MALINGERING   ANAESTHETICS :  
OPERATIONS . DEFORMITIES

### HAEMORRHAGE.

SOME of the most serious symptoms immediately following injury are due to haemorrhage if this is severe

These symptoms do not show themselves unless the loss of blood is considerable, e g half a pint or more.

SYMPTOMS Pallor , rapid and feeble pulse , restlessness , coldness of the skin , thirst and unconsciousness

These symptoms are due to two causes : (1) the loss of fluid, and (11) the loss of oxygenating power in the tissues

Of these the most important in its immediate effects is the first and, provided the bleeding can be stopped and fluid replaced, e g by injection of normal saline solution (corresponding in concentration to the fluid of the blood), recovery may take place even in most serious cases The oxygenating power depends on the re-forming of blood corpuscles, and this, if the patient is otherwise healthy, may take from a few days to three or four weeks

### Varieties of Haemorrhage.

ARTERIAL Bleeding from an artery is more serious than from a vein owing to the force with which the blood is shed It issues, bright red in colour, in spurts, and if a large artery is damaged death may ensue almost immediately.

VENOUS The blood flows from the vein in a steady flow, and is darkish in colour It comes from the cut-end of the vein that is farthest from the heart, as the blood is normally flowing towards the heart, and in this respect differs from arterial haemorrhage, which comes from the cut arterial end nearest the heart

PRIMARY HAEMORRHAGE The bleeding that occurs as soon as an injury is inflicted is called primary haemorrhage

SECONDARY HAEMORRHAGE If a wound is infected and pus

forms with some destruction of tissue owing to this, small or large vessels may be partially destroyed and bleeding start again after the primary haemorrhage has been stopped. This is known as "secondary haemorrhage," and may occur on the third or subsequent days after the infection has started.

It is very serious as a rule, owing to the difficulty of controlling it when the arterial walls are infected. Whenever a wound is infected in the neighbourhood of a main arterial vessel, this risk is a very great one.

**DURATION OF EFFECTS OF HAEMORRHAGE.** Patients often complain for months after an injury accompanied by loss of blood, that they are still suffering as a result of this. This is usually untrue, as an otherwise healthy patient will re-form the blood lost within a few weeks of the injury.

## INFLAMMATION.

By inflammation is meant the reaction of the body tissues to an irritant.

**CAUSE** Any form of irritant may cause signs of inflammation, but, in the case of chemical or mechanical irritants, as soon as the irritating substance is removed the inflammation subsides. In the case of irritation from microbes the same is true, but the difficulty in this case is to remove the microbe, and this cannot be done merely by washing or cleansing in the ordinary way. Some antiseptic has to be used to destroy the organisms, and as these rapidly penetrate into the tissues, it may be impossible to reach them by antiseptics. Further, antiseptics to be effective may have to be so strong as to be in themselves an irritant.

### Chemical and Mechanical Irritants.

The signs of inflammation caused by chemical and mechanical irritants appear a few hours after the cause begins to operate, and the course of the case depends on the amount of damage done to the tissues before the irritant is removed. It must be remembered that dead tissue cells (produced by any irritant) themselves act as an irritant, and continue to do so until they are separated from the living cells. The duration of inflammation from such a cause depends, therefore, primarily on the extent of damage done to the

tissues by the irritant before this is removed. Repair then proceeds normally as for clean granulating wounds. (See *Wounds*.)

As the wound caused by these forms of irritants is frequently in the form of an ulcer, the reader is referred to the notes on ulcers for further information.

### Microbic Irritants (Sepsis)

This is the commonest cause of inflammation as ordinarily understood. Microbes are present universally under ordinary conditions and only need an opportunity to gain access to the body tissues to excite inflammation. Normally, the outer layers of the skin and mucous membranes afford sufficient protection, but if these surfaces are wounded even to the slightest extent (such a wound may be practically invisible), organisms may infect the cells so exposed and a septic inflammation is set up.

In other cases the microbes may penetrate into the small glands of the skin through the openings of these glands on the surface (pores of the skin) and set up inflammation.

However the microbes may enter, the reaction known as Inflammation starts at once, although it is not usually apparent (as redness, swelling, etc.), for from three hours to three days after the infection. In exceptional cases five or six days may elapse, but any longer period is extremely improbable. Such a variability in the time is due to the differing virulence of the organisms which may be present. It is sometimes of extreme medico-legal importance to determine the first time of onset of the signs of inflammation, so as to establish, if possible, the time at which infection occurred.

### Course of Septic Inflammation.

The inflammatory reaction of the tissues will continue until one of two things happens, i.e. until either the patient or the microbes are destroyed. The offensive powers of the microbes lie in their production of toxins or poisons which, by their action, destroy the living cells, and if allowed to circulate in large quantities in the blood, and are conveyed to the cells of the brain or heart, or other vital organ, may so impair their vitality as to cause their normal activities to cease, and death to ensue.

The defensive powers of the patient lie in the ability of the white



blood corpuscles to absorb and destroy the microbes, and in the production by the blood of substances (anti-toxins or anti-bodies) which neutralize the toxins of the bacteria and destroy the bacteria themselves

The duration of inflammation, therefore, depends on the relative strength of these two opposing forces. If the bacteria are overpoweringly strong, the fight will be short and the death of the patient may follow in the course of a few days. If the defensive mechanism of the blood is strong, the opposite result may be reached equally rapidly. If, however, the opposing forces are more equal, the duration of the fight and so of the symptoms, may be indefinitely prolonged.

### **Abscess Formation.**

As the struggle between the microbes and blood progresses, an accumulation of dead and living microbes and white blood cells, together with tissue cells destroyed by the microbes, occurs, and such a collection of dead cells and living microbes is called pus ("Matter")

Such a collection may occur wherever septic inflammation exists, and if the pus is formed beneath the surface the resulting swelling is an abscess.

In the normal course of inflammation such an abscess may develop at any time after the third day from the onset of signs of inflammation (this must not be confused with the date of the first infection by microbes, which may take place two or three days before the onset of signs of inflammation see above). An abscess will continue to increase in size and the infecting organisms destroy the surrounding tissues until the abscess reaches the surface by destruction of the intervening tissue, and the skin breaks, so discharging the pus, or if the abscess is deep-seated until the patient dies of septicaemia or pyaemia (*qv*).

**COLD ABSCESS** By this is meant an abscess due to an organism of low virulence, usually to the tubercle bacillus, in which the signs of acute inflammation are absent. The symptoms and infection being less acute in these cases, the patient may suffer very little ill-effects until a gradual condition of exhaustion sets in, as the abscess increases in size or fresh ones are formed.

Such abscesses run a prolonged course and may be extremely difficult to cure

### Signs and Symptoms of Inflammation.

The classical signs of inflammation are redness, local heat, pain, and swelling. The temperature of the body is raised, the degree depending on the virulence of the infection.

### Complications.

- 1 Abscess formation (see above)
- 2 Extension of the inflammation up the lymphatics, which may appear as red streaks under the skin (lymphangitis) to the lymphatic glands, which become enlarged and painful, and may break down forming an abscess (lymphadenitis)
- 3 Septicaemia and pyaemia (*q v*)

### Relation of Inflammation to Injury.

Any injury which causes a break in the skin, however trivial, may cause a septic inflammation

In this connection it might be emphasized that septic inflammation cannot be produced by any cause except bacteria. The dye of a stocking or oil or paint, or any other foreign matter will not produce a septic inflammation unless bacteria are carried into the wound

An apparently clean, sharp razor may be virulently infective, whereas the thickest oil or reddest of red lead may be perfectly innocuous. If the skin is not broken, inflammation may still occur. This is caused by blood being extravasated at the site of the injury, either by a blow causing a definite bruise or by some ligamentous or muscular fibres being torn. Such an extravasation of blood may become infected by stray organisms being deposited in it from the blood stream, in which such organisms frequently occur without giving rise to any symptoms until they are given an opportunity of multiplying, such as is provided by even the most minute blood clot. In such a manner osteo-myelitis (*q v*) may be caused by a strain of a joint causing tearing of ligaments inserted into the bone

### Latent Infection.

It sometimes occurs that an injury may "light up" a local infection in a part which has previously been the seat of a septic infection but which has apparently completely healed.

Cases of tubercular joints and osteitis are common examples of this type of case

The probable explanation is that the organisms present at the first infection have not been completely destroyed, and have remained dormant. When a comparatively trivial injury is subsequently sustained by the part, the slight bruising or decrease in resisting power of the local cells caused by the second injury may enable the bacteria to start growing again, giving rise to symptoms as acute or more so than on the first occasion. It is for this reason that surgeons are chary of operating on a part that has been the site of a previous infection.

The danger of "lighting up" an infection may persist for twelve months after the infection has apparently completely subsided.

### MALINGERING.

True malingering, i.e. the attempt to simulate a disease, is comparatively rare. A common form of malingering is to pretend that some accident is causing incapacity when the patient knows that he is really fit for work. This is a fairly common attempt at fraud, but it is rarely that such a patient can impose upon an experienced medical man. There are so many necessary factors that must be taken into account by the patient in order successfully to deceive in this way, that it is only rarely that the man carries it through a careful medical examination without losing his nerve.

The commonest attempt is that of exaggeration of symptoms which may be present. The difficulty in dealing with a case of this sort is that the presence of the symptoms cannot be denied, and an estimation of their probable intensity is sometimes difficult. Various methods of testing these symptoms without the knowledge of the patient are employed by medical men experienced in this work, but most frequently the only way of arriving at a true opinion is to compare the alleged severity of the symptoms with the actual physical abnormality that is present.

In all cases the word "Malingering" should be applied only when it is obvious that the man is deliberately attempting to deceive, and on this account the word is more and more rarely used now in courts of law

The great majority of cases for which the term used to be employed are those where the patient is unknowingly taking an exaggerated view of his symptoms. A patient may, by brooding on his misfortunes, genuinely persuade himself that he is totally unfit for work and will remain so, or unconscious suggestions may be operating in his mind from conversations he has heard with regard to other workmen who have been, as he thinks, similarly injured, and have suffered permanent disability, or he may be a pure neurotic, or he may be afraid of losing his post if he returns to work and cannot carry it out as well as before

All these types are common, and form the large majority of cases of exaggeration of symptoms. To deal with these requires considerable experience on the part of the medical examiner, and the insurance official who is dealing with the claim, as each case must be treated entirely on its merits

## ANAESTHETICS.

Surgery owes its enormous progress during the last fifty years to two discoveries. Anaesthetics and Antiseptics. Operations which, before the discovery of anaesthetics, were performed only as a last resort are now undertaken in the early stage of disease with incalculable benefit to patients

There are many forms of anaesthetics, but they may be divided into two main groups, local and general

### Local Anaesthetics.

These are administered with the object of making insensitive a comparatively small area, so that in suitable cases operations can be performed without the dangers and inconvenience of a general anaesthetic. The anaesthetic is usually given through a hollow hypodermic needle, and the one most usually employed now is Novocain

Another modern method of administering anaesthetics is by injecting Stovain into the spinal canal. This paralyses and

anaesthetises temporarily the nerves below the level at which the injection is made. No ill-effects are likely to follow, although persistent headache has been recorded.

Cocaine is rarely used nowadays as a local anaesthetic owing to the danger of its use. Symptoms of pallor, feeble heart's action, and unconsciousness may result from its use, even in comparatively small doses.

### General Anaesthetics.

These are administered by inhalation into the lungs of the anaesthetic vapour. The commonest anaesthetics used are ether, chloroform, ethyl chloride, and nitrous oxide gas. These all operate by being absorbed through the lungs into the blood, and being so carried to the brain.

The after effects of the administration of such anaesthetics are important.

**NITROUS OXIDE ( $N_2O$ ).** Nil. Fatalities are extremely rare, but are still occasionally reported.

**ETHYL CHLORIDE.** If administered too quickly heart failure and death may result.

**CHLOROFORM.** Heart failure may follow in patients with hearts already weak or fatty. A condition known as "delayed chloroform poisoning" may develop a few days after the anaesthetic has been administered and is characterized by gradual loss of consciousness, and death. Changes in the liver are found post mortem.

**ETHER.** This is one of the safest anaesthetics, but it unfortunately tends to irritate the lungs and bronchitis and even pneumonia may follow its administration.

Vomiting frequently occurs immediately as the sequela of the administration of any of the above anaesthetics, except nitrous oxide, but does not, as a rule, last more than twenty-four hours.

### Operations.

The after effects of an operation depend almost entirely on the nature of the operation and the condition for which it is performed. In cases of quite small operations, e.g. removal of a small cyst, circumcision, removal of tonsils and adenoids, etc., the disability varies from a day or two to one to two weeks.

In more important operations, e g for rupture or appendicitis (uncomplicated), or other similar abdominal operations, the patient is usually completely disabled for three to four weeks, and owing to danger of the scar stretching (particularly in the case of abdominal operations) should not do heavy work for three months after the operation

In major operations, i e operations of a serious nature, e g for removal of a growth, removal of a kidney, gall stones, extensive operations on the stomach, etc, total incapacity may last from six to eight weeks, and partial incapacity for another six or eight weeks at least, and in some cases partial incapacity may be permanent

## DEFORMITIES.

Deformities of any part of the body may be congenital or acquired. In both forms, broadly speaking, one of three degrees of deformity may be present. These three degrees are—

- 1 Where the deformity is due to abnormality of the soft parts (e g of muscles, tendons, ligaments or skin), and can be corrected by manipulation

- 2 Where the deformity is as in (1) but cannot be corrected by manipulation, unless the parts maintaining the deformity are first divided by operation

- 3 Where the deformity involves the skeleton

The chances of permanently correcting the deformity and the length of time this will take are different in each of these groups. In the first group the chance of permanent correction is better than in the second, and in the second it is better than in the third. The length of time necessary for complete recovery (other things being equal) is shortest in the first group and longest in the last.

Acquired deformities may be due to injury or disease. Deformities due to injury are innumerable. Fractured bones badly united, torn or stretched ligaments, e g in the sole of the foot, adhesions caused by scarring which has contracted, extensive scarring from burns, are common examples of the causes of such deformities.

Injuries to nerves resulting in paralysis of certain groups of muscles leaving the opposing muscles free to contract frequently give rise to deformity of the joints activated by the affected muscles.

Disease may cause deformity by affecting the bones, e g the bones may become soft, as in rickets, and bend, they may be gradually eaten away by tubercle as in tubercular disease of the spine. Disease may affect the nerves as in infantile paralysis, causing paralysis of groups of muscles and resulting deformity from contraction of the opposite groups as described above.

Disease of joints may, by destruction of the articular surfaces in an irregular way, give rise to deformity, e g arthritis deformans, rheumatoid arthritis, advanced tubercular disease.

### **Relation of Chronic Joint Disease to Injury.**

It is common for workmen suffering from some chronic joint disease, such as osteo-arthritis or rheumatoid arthritis, to claim that the incapacity resulting therefrom is due to some injury which may have occurred. Such claims should always be most carefully criticized, because otherwise an employer may be saddled with the responsibility for an incapacity which is really due solely to a progressive disease and not to any injury.

It must be recognized that joint diseases such as osteo-arthritis or tubercle, may follow an injury and if, as is usually the case with tubercle, and frequently with osteo-arthritis, the disease is confined to the joint injured, it is impossible to dispute that the injury may have precipitated the disease. This, however, can be so only if the changes present in the joint are of such a degree as would be expected, if the disease started at the date of the accident.

It frequently happens, however, that the signs are much more advanced than would be possible in the given time. In such cases it is usually and frequently justly claimed that the disease has been aggravated by the accident. If the disease is confined to one joint, it is difficult, if not impossible, to dispute such a claim, but if other joints are also affected, as, for example, is frequently the case in osteo-arthritis, a comparison between the injured joint and another may well show that the disease is no more advanced in the injured one.

### **Deformities of the Spine.**

Those commonly met with in children will not be described. All deformities of the spine show themselves as alterations in the natural curves.

There are three technical terms used to describe these curves, viz —

1 Lordosis 2 Kyphosis 3 Scoliosis

1 *Lordosis* is a curvature of the spine with its concavity backwards

2 *Kyphosis* is one with the concavity forwards.

3 *Scoliosis* is a curve with the concavity to the right or left, i.e. a lateral curve

These curves (especially Lordosis and Kyphosis) may be gradual curves or angular.

*Gradual curves* of the spine may be due to muscular weakness causing inability to maintain the vertebrae in their natural position, or to a *general* disease of the vertebrae, possibly causing softening of the bones as in rickets, or small deformities of the intervertebral joints which in the aggregate may give rise to marked curvature, although the deformity of each separate joint may be slight (e.g. in osteo-arthritis or, as it is called when it affects the spine, Spondylitis Deformans)

*Angular curvature*, on the other hand, is due to abnormality confined to one or two neighbouring vertebrae, in which the bodies have become crushed together, giving rise to a prominence confined to one or two vertebrae. The common cause for this is tubercle which, by eroding the bodies of neighbouring vertebrae, causes them to collapse and so form an angular curve. Injury may produce the same effect if fracture of the vertebral bodies has occurred, but if there is sufficient displacement in these cases to give rise to a definite angular curve, the patient rarely survives owing to the pressure on the spinal cord. The reason the spinal cord is frequently unaffected (though by no means is this always the case) in tubercle, is that the process is a gradual one and the spinal cord has time to accommodate itself.

*Disability* due to spinal deformity depends generally on the degree of stiffness of the back associated with it, and on the cause of the deformity. If due to tubercular disease or fracture of a vertebral body the disability may be complete for heavy work even when the condition has become stationary.

In cases where the deformity develops gradually and affects the



whole spine, e g in rickets or osteo-arthritis, the disability may be only slight, but it is in these cases that a trivial injury amounting to no more than a slight twist may precipitate symptoms of pain and stiffness which may be very prolonged and give rise to disability out of all proportion to the severity of the injury

### Deformities of the Limbs.

*Nomenclature* In describing deformities of the joints of the limbs special terms are used, the most important being " Varus " and " Valgus " The term " Varus " or " Varum " is used to describe a deformity in which the joint is bent with its convexity away from the middle line of the body, e g Genu Varum (Bow-legged), and " Valgus " or " Valgum " is used in the opposite sense, e g Genu Valgum (knock-kneed)

**UPPER LIMB** Apart from rare congenital deformities which need not be mentioned here, the common deformities of the upper limbs are those due to injury, e g badly set fractures, particularly if they involve the elbow or wrist joint, burns causing deep scarring which, by its contraction, may give rise to deformity, etc

*Shoulder* Deformities of this joint are very rare, but in this place a word might be said about disability due to limitation of movement of the joint

It is sometimes overlooked that the shoulder joint may be completely stiff and yet some movement of the arm on the trunk may be possible This is due to the fact that the joint is formed by the humerus and scapula, and the latter is free to move on the chest wall, so that, if the humerus is firmly fixed to the scapula, movement is possible by moving the humerus and scapula together The range of movement so allowed is only about one-third the normal range

The degree of disability caused by limitation of movement of the shoulder can be estimated fairly easily by the exercise of common sense, having regard to the nature of the work normally done by the man It must, however, be remembered that in the case of the shoulder, if the scapula has to be brought into play in order to get a range of movement which normally would not need the movement of this bone, the power of such movements must be appreciably less than normal

*Elbow Joint* The commonest deformities of this joint are those in which there is limitation of movement of the joint, either partial or complete. The cause may be either disease (any variety of arthritis or osteo-arthritis may produce this limitation of movement) or injury (fracture into or near the joint)

From the point of view of the working power of a man, any considerable degree of limitation of movement of this joint may be very serious. Disability is more marked if flexion is limited than if extension is limited, as in the former case lifting power is seriously hampered. If the joint is completely fixed, the arm is almost useless for any ordinary work if it is in the fully-extended position. If flexed at a right angle or a little less, its use is considerably greater although for ordinary manual work it is not of much value.

In some cases of fracture of the lower end of the humerus near the elbow joint (affecting the condyles) the elbow may be deformed, so that the forearm is bent inwards or outwards. If the former, the condition is known as *Cubitus varus*, and if the latter *Cubitus valgus*.

*Wrist Joint* Deformity of this joint is most commonly due to Colles' fracture (*qv*). Injuries to the tendons of the wrist may give rise to fixation of the joint in a deformed position (most commonly flexed). Such a deformity owes most of its resulting disability to the fixation of the tendons which interfere with the gripping power of the hand.

*Thumb and Fingers* Deformity of any of the digits is generally due either to fractures or dislocations of the bones or joints, or to injuries to the tendons of the digits.

Deformities that cannot be corrected by manipulation are due either to fixation of the joints as the result of fractures or disease, or to adherent tendons involved in scar tissue as the result of lacerated wounds or sepsis.

The degree of disability due to such deformities varies inversely with the distance of the joint from the base of the digit, i.e. fixation of the metacarpo-phalangeal joint is a much more serious thing than of the first interphalangeal joint, while fixation of the second, or terminal interphalangeal joint may give rise to little or no disability. In all cases deformity of the thumb is more disabling

than that of a finger, the disability being at least twice as great for corresponding injuries

In many cases the disability due to fixation of a joint of the fingers, particularly of the metacarpo-phalangeal joint, is due to the fact that the finger "gets in the way" when the hand is used and amputation may be needed to get over this difficulty.

**DUPUYTREN'S CONTRACTION** This is a deformity of the fingers due to the development of a thickening of the soft tissues underlying the skin of the palm

*Cause* This is not definitely known, but is generally attributed to constant pressure on the palm from tools. It does not follow accidental injury, though it may be so aggravated

*Symptoms.* The thickened tissues contract and pull down the fingers so that they become flexed and cannot be straightened actively or passively. The grip is seriously impaired, owing in extreme cases to the inability to extend the fingers sufficiently to grip. The second and third fingers are the ones usually affected

*Duration.* The deformity is a progressive one, and it is only in the very early stages that prolonged treatment and relief from all pressure may effect improvement

#### LOWER LIMB—

*Hip Joint* This joint may be deformed as the result of disease (tubercle or osteo-arthritis) or injury. The commonest injury in this region is a fracture of the neck of the femur. The common deformity in this joint is termed Coxa Vara, this being produced when the angle of the neck of the femur with the shaft, is diminished, i.e. becomes nearer a right angle. The term is derived from Coxa (hip joint) and Vara (explained above), the effect of the alteration in the angle of the neck of the bone being to cause the thigh and leg to be bent inwards towards the middle line. This is corrected by the patient's abducting the limb, i.e. carrying it away from the middle line, so as to bring the limb straight. If the deformity is not marked, this can usually be done, but it is impossible to carry the leg much outwards owing to the neck of the bone and great trochanter striking the upper border of the acetabulum, if this is attempted. Defective abduction of the limb is, therefore, the chief disability in slight cases

In cases where the deformity is very marked, it may be impossible to get the leg far enough out to bring it parallel with the normal limb, rendering walking impossible

Coxa vara is commonly caused by fracture of the neck of the bone, but a similar deformity may be produced in a rather different manner by disease wearing away the head of the bone or the acetabulum, and causing displacement of these parts. Tubercle and osteo-arthritis are common causes of this

Frequently as the result of disease and occasionally as the result of a fracture, the hip may become fixed in a partially flexed position. The importance of these deformities of the hip are twofold. (1) Any such deformity limits the range of movement and so the process of locomotion and (2) in attempting to correct the deformities, the patients frequently develop curvature of the spine, by forcibly tilting the pelvis to bring the leg into proper alignment with the sound limb

*Knee Joint* The two common deformities of this joint are Genu Varum (bow legs) and Genu Valgum (knock-knees)

The commonest cause of either of these is developmental, the bones being slightly bent or unevenly developed owing to too rapid growth or incomplete hardening (e.g. in rickets). Injury to the condyles of the femur or tibia may produce the same effect

A slight degree of such deformity is not disabling, but if either (particularly the valgus deformity) is marked, the knee joint is much weakened and disability is experienced in locomotion and in weight carrying

A common sequela of the valgus deformity is the development of flat foot (pes planus), owing to the foot being displaced outwards from the knee and the weight of the body, therefore, thrown too much on the inner border of the foot

*Ankle Joint and Foot* Most of the common deformities in the region of the ankle and foot are due to abnormalities in the tarsal bones and joints, caused by deformity of the bones themselves, or due to weakening of the ligaments and tendons supporting the joints of the tarsus

Such deformities may be congenital (Congenital Club foot) or acquired

In the former case the musculature of the leg and ankle is usually

fully developed, but the bones are either deformed or slightly displaced. In the acquired variety there is usually either a history of direct injury to the foot, or else the condition is secondary either to a deformity of the leg elsewhere (e.g. deformity of the knees, Pott's fracture with deformity just above the ankle joint), or to weakness or paralysis of the muscles and tendons passing over the ankle joint, and resulting in the weakening of the support normally afforded by these structures.

### Varieties of Deformities of the Foot and Ankle.

1 *Pes Planus* (Flat foot) This is the commonest of all deformities of the foot, and consists of a flattening of the normal arch of the foot on its inner border. It is produced by stretching of the strong ligaments (plantar ligaments) which normally act as a stay for the arch (see *Anatomy of the Foot*) and so causes the arch to collapse and the front part of the foot to be turned slightly outwards.

It is a very crippling condition, as all the spring of the foot is lost and the head of the astragalus in extreme cases comes to rest on the ground, giving rise to great pain.

It can be remedied to some extent by wearing an artificial support, but in extreme cases full correction cannot be effected and the individual is permanently handicapped for heavy labouring work.

2 *Pes Cavus* (literally Hollow Foot) In this deformity the arch of the foot is accentuated and the foot thereby shortened. The heel is more vertical than it should be, and the toes more pointed.

It is usually congenital, and if well marked is disabling owing to the tightness of the parts and comparative instability owing to the shortening of the foot. It is seldom due to accident.

3 *Talipes Equinus* (Talus = ankle, Pes = foot, Equinus = a horse) A deformity in which the toes and front part of the foot are pulled downwards so that the foot is extended and the heel cannot be brought to the ground.

It is usually congenital but a similar condition may be produced by contraction of the Tendo-Achilles (heel tendon) due to injury or disease. It can usually be corrected by dividing or forcibly stretching the tendo-achilles.

4 *Talipes Equino-Varus* or *Talipes Varus* In this deformity the foot is displaced inwards (varus) and the toes somewhat pointed (equinus) If the deformity is confined to the inward displacement the term talipes varus is used, but as usually there is also some pointing of the toes, the term equino-varus is the more accurate

It is usually congenital and is popularly called Club Foot.

5 *Talipes Valgus* In this deformity the foot (especially the front part) is displaced outwards The weight being thrown on the inner side, a great strain is thrown on the arch of the foot which usually gives way, and so produces in addition, a flat foot (*Pes Planus*, *qv*)

One of the commonest accidental causes of this deformity is a Pott's fracture which has been badly set (see *Fractures*). *Genu Valgum* (knock-knees) or any other condition of the lower limb, such as an angular deformity of the leg due to a badly-set fracture of both tibia and fibula, which throws the ankle outwards and so causes strain on the inner side of the ankle, is likely to give rise to the deformity It is also frequently due to infantile paralysis or other form of paralysis of the calf muscles, whose tendons (especially the *tibialis posticus*) normally assist in the support of the inner side of the ankle



# APPENDIX

## GLOSSARY OF COMMON MEDICAL TERMS AND DISEASES

- The termination "itis" means inflammation  
 "otomy" " a cutting open  
 "uria" " in the urine  
 "opia" " vision, e g Myopia, " short sight "  
 "algia" " pain  
 "oma" " tumour, e g Carcinoma (Cancer)
- The letters "haem" refer to blood, e g Haematemesis, vomiting of blood  
 "rrh" often occur with the meaning "to flow down," e g  
 Diarrhoea  
 "ost" and "oss" refer to bone, e g Osteoma, a bony tumour  
 "ot" refer to the ear, e g Otitis, inflammation of the ear  
 "dys" mean "difficulty in," e g Dyspepsia, difficulty in digesting  
 "phobia," Literally "fear of," e g Photophobia (fear of light)  
 "pseudo" " False," "like," or "untrue," e g Pseudo-angina,  
 a disease similar to but not exactly the same as true Angina  
 "arth," "joint," e g Arthritis, inflammation of joint  
 "ectomy," "cutting out," e g Appendectomy, removal of  
 appendix  
 "ostomy," "making an artificial opening," e g Colostomy, making  
 an artificial opening into the colon

## GLOSSARY OF TERMS AND DISEASES

- Abdomen.** Part of the trunk, lying between the thorax and the pelvis  
**Abrasion.** Graze  
**Abscess.** Collection of pus, the result of inflammation  
**Achondroplasia.** An abnormality of growth, in which the development or growth of the bones of the limbs is incomplete, resulting in dwarfing Incurable  
**Acromegaly.** A disease affecting the growth of bones, due to abnormality of the pituitary gland The skeleton is overgrown, the most marked signs being overgrowth of the jaw, hands, and feet A progressive disease  
**Acute.** Term applied to diseases which are sudden in onset, and of comparatively short duration  
**Acute Yellow Atrophy.** A rare disease of the liver, characterized by wasting of this organ and intense jaundice Cause unknown, invariably fatal  
**Adenitis.** Inflammation of the lymphatic glands  
**Adipose Tissue.** Tissue composed of fat cells  
**Aetiology.** Study of the causation of a disease  
**Alimentary.** Pertaining to the intestinal canal, or the taking of food  
**Alopecia.** Baldness  
**Alveolar.** Pertaining to the margin of the jaw, or to the small air sacs of the lungs  
**Amaurosis.** Blindness  
**Amblyopia.** Blindness, in both eyes  
**Amenorrhoea.** Stoppage of the menstrual flow  
**Ametropia.** Abnormality of vision  
**Amoeba.** Minute organism composed of one cell, consisting of clear protoplasm with a central nucleus capable of independent locomotion



- Anasarca.** Dropsy
- Angioma.** A tumour composed of blood-vessels
- Anorexia.** Loss of appetite
- Anterior.** Lying towards the front
- Antisepsis.** Processes adopted to destroy germs
- Antiseptic.** Having the property of killing germs
- Anuria.** Cessation of urinary secretion
- Aortic Regurgitation.** Abnormal flowing back of the blood into the heart through the aortic valves, owing to their incompetence, due to valvular disease of the heart
- Aortic Stenosis.** Narrowing of the aortic orifice of the heart due to valvular disease, throwing extra strain on the heart muscle
- Aphasia.** Loss of power of speech
- Aphonia.** Loss of power of articulation.
- Arcus Senilis.** A white rim formed round the outer margin of the cornea due to advancing years
- Argyll Robertson Pupil.** An abnormality of the pupil reflex, occurring characteristically in tabes dorsalis. The pupil reacts to accommodation, becoming smaller when looking at near objects, but does not react to light
- Arrhythmia.** Irregularity of rhythm
- Arterio-venous Aneurism.** An abnormal communication between an artery and a vein, caused usually by injury, and resulting in interference in the circulation of the neighbouring parts
- Arteritis.** Inflammation of the lining of the arteries, commonly due to syphilis and causing defective nutrition
- Articular.** Pertaining to a joint
- Articulation.** A joint
- Ascites.** Collection of fluid free in the abdominal cavity, commonly due to disease of the liver, heart, or peritoneum
- Asepsis.** Surgical cleanliness, freedom from germs
- Aspiration.** The withdrawal of fluid from a cavity by means of a hollow needle or tube
- Asthenia.** Wasting
- Ataxia.** Loss of control of the lower limbs
- Atheroma.** Disease of the lining of the arteries, associated with destruction of this in parts, and deposit of chalky material due to old age, frequently follows syphilis
- Atheromatous.** Having characteristics of Atheroma
- Atrophy.** Wasting of tissues
- Auricular.** Pertaining to the ear, or the auricle of the heart.
- Autopsy.** Post mortem examination
- Axilla.** Armpit
- Bacilli** (singular, *Bacillus*). Rod-shaped organisms, causing infection and disease of various kinds
- Bacilluria.** Bacilli in urine
- Bacteria.** Generic name given to all microscopic germs, whether harmful or not
- Baker's Cysts.** Pouches of synovial membrane connected with a joint which may become distended with fluid, giving rise to local symptoms
- Balanitis.** Inflammation of the terminal portion of the penis
- Bed-sores.** Inflammation and ulceration of the skin, caused by pressure of the weight of the body in patients long confined to bed. They usually indicate poor nutrition, possibly due to constitutional disease
- Bifurcation.** Branching
- Billharzia-haematobia.** An organism prevalent in the tropics, particularly Egypt, which causes symptoms of urinary trouble by getting into the bladder

- Botulism.** Form of ptomaine poisoning
- Bowel.** Popular name given to the small or large intestine
- Brachial.** Pertaining to the arm
- Bradycardia.** Abnormal slowing of the heart, usually due to some abnormality of the heart itself
- Bronchiectasis.** Condition of the lungs due to disease, whereby cavities appear and the function of the lungs is thereby much interfered with  
Commonly due to tubercle or septic lung condition
- Bruit.** An abnormal heart sound which indicates, if well-marked, valvular disease In some cases it may be due to weak muscular action of the heart
- Bubo.** Term sometimes given to a large inflamed lymphatic gland
- Bubonocoele.** A partial rupture in the inguinal canal
- Bulla.** Blister
- Bunion.** An abnormal space containing fluid, formed over the great toe joint It is nature's method of preventing undue pressure on the joint
- Bursa.** A fluid-containing sac found over bony points in various parts of the body, and sometimes between bone and tendons or muscle They act as a cushion to prevent undue pressure or friction
- Cachexia.** General poisoning of the system, commonly due to cancer, and due probably to absorption of toxins
- Calcareous Degeneration.** A degenerative change in the tissues, accompanied by the deposit of chalky material, due to chronic inflammatory changes, e.g. tubercle, or old age
- Calculus.** Stone
- Callosity.** A local thickening of the skin, usually due to pressure
- Cancellous.** Loosely-built tissue, usually applied to the marrow of bone
- Cancerum Oris.** Semi-gangrenous inflammation of the lining of the mouth, usually found in debilitated children
- Capillary.** The most minute terminal branches of the blood-vessels
- Capsule.** Fibrous covering to an organ
- Carbo-hydrates.** Food of the sugar and starch class
- Cardiac.** Pertaining to the heart
- Cardiac Disease.** Disease of the heart
- Cardiac Murmurs.** Abnormal sounds produced by the heart in valvular disease, or sometimes due to slight abnormalities of the action of the heart muscle
- Caries.** Decay
- Carious.** Decayed
- Carpal.** Pertaining to the small bones of the hand, near the wrist
- Cartilage.** Smooth covering of the bones at a joint, or where growth takes place (See *Bones*)
- Caseation.** Formation of caseous material
- Caseous.** Literally "cheesy" Caseous material is frequently the result of chronic inflammation, commonly met with in lymphatic glands
- Castration.** Removal of the testicles
- Casts.** Cylindrical albuminous bodies derived from the tubules of the kidneys in chronic disease of these organs
- Catalepsy.** A trance-like condition of which the cause is unknown, in which consciousness is lost and death may be simulated
- Catarrh.** Mild inflammatory condition of mucous membranes
- Cauda Equina.** The lower extremity of the spinal cord
- Cellulitis.** Inflammation of the subcutaneous, or other connective, tissue of the body
- Cephalalgia.** Pain in the head
- Cephalic.** Pertaining to the head
- Cephalhaematoma.** Collection of blood beneath the scalp

**Cerumen.** Wax

**Cervical.** Pertaining to the neck

**Cervical Plexus.** A network of nerves, situated in the neck, derived from the upper cervical spinal nerves

**Cervix Uteri.** The neck of the womb

**Charcot's Joint Disease.** An arthritis usually attributed to syphilis, associated with great destruction of the joint surfaces and deformity  
**Incurable**

**Cheloid.** Scar which tends to increase in size in the manner of a growth, sometimes giving rise to considerable deformity Not uncommon following burns, and may arise from a most minute scar

**Chemosis.** Oedema of the conjunctiva

**Cholangitis.** Inflammation of bile duct

**Cholecystectomy.** Excision of the gall bladder

**Cholecyst-enterostomy.** An artificial opening made by a surgeon between the gall bladder and small intestine, in cases where the bile duct is obstructed

**Cholecystitis.** Inflammation of the gall bladder

**Cholecystotomy.** The operation of opening the gall bladder

**Choledochotomy.** The operation of opening the bile duct

**Chondritis.** Inflammation of cartilage

**Chronic.** Opposed to acute A term applied to conditions of gradual onset and slow progress Many acute conditions may become chronic

**Cicatrix.** Scar

**Circumcision.** Removal of the prepuce

**Cirrhosis.** A chronic change characterized by the development in the organs of fibrous tissue

**Claw-hand.** Deformity of the fingers, which assume a clawlike form owing to paralysis of the nerves of the forearm

**Cleft palate.** Congenital deformity, whereby the hard palate is incompletely formed, a gap being left down the centre It causes difficulty in swallowing and in speech

**Clonus.** A rapid involuntary contraction of muscles Ankle clonus is a clonus of the calf muscles demonstrated by fully flexing the foot, spasmodic movements taking place at the ankle joint It is found in cases of disease of the upper part of the spinal cord or brain

**Colic.** Acute, spasmodic pain usually due to the effort of a viscus to overcome some obstruction, or to irregular peristaltic waves in the bowel May be caused by stones in the kidney (renal colic), or in the bile ducts (biliary colic)

**Collapse.** A term used to describe the condition of a patient suffering from profound nervous shock or loss of blood

**Colostomy (Colotomy)** An artificial opening made by a surgeon in the colon, so that the contents of the bowel are evacuated through the abdominal wall It is necessitated in cases of obstruction of the large bowel

**Coma.** A condition of unconsciousness from which the patient cannot be roused May be due to head injuries or to poisons in the blood, e g in diabetes and kidney disease

**Comatose.** The state of being in coma

**Concave.** A surface is said to be concave when it is hollowed out, e g the inside curve of a saucer

**Condyle.** A normal projection found at the extremity of long bones

**Condylomata.** Special warts found on the skin in syphilitic conditions

**Congenital.** Present from birth

**Congenital Heart Affections.** The commonest abnormality of the heart from birth is the incomplete closure of the division between the two sides of the heart Symptoms due to this are similar to those of valvular disease of the heart

**Congestion.** Engorgement by dilated blood-vessels, present in most inflammatory conditions

**Connective Tissue.** Fibrous tissue of a loose texture found between muscles and beneath the skin It also occurs round many of the viscera, e g kidneys, spleen, etc

**Constipation.** Abnormally infrequent evacuation of the large bowel  
**Costiveness**

**Consumption.** Popular term for tuberculous infections

**Contagion.** Spread of disease by contact of individuals

**Contraction.** Shortening

**Contracture.** Shortening.

**Convex.** Surface is said to be convex when it is shaped like the outside of part of the sphere, e g an inverted saucer

**Convulsions.** Fits of a spasmodic character.

**Cordis.** Of the heart, e g Morbus Cordis (heart disease)

**Corns.** A thickening of the outer layers of the skin due to constant pressure

**Coronary Arteries.** Small arteries arising from the aorta at the base of the heart They supply the heart muscle with blood.

**Costal.** Pertaining to the ribs

**Costiveness.** (See *Constipation*)

**Coxa.** The hip joint

**Cramp.** Acute spasmodic muscular pain Caused by irregular contraction of the muscles

**Crepitus.** Grating felt between the fractured ends of a bone

**Cretinism.** Defective growth of the skeleton and general lack of development, mentally and physically, due to lack of thyroid secretion.

**Crisis.** In certain diseases, e g pneumonia, improvement in the condition of the patient from the point of death to comparative comfort may occur in a few hours Such a change is technically termed "crisis"

**Cutaneous.** Pertaining to the skin.

**Cuticle.** The outer layer of the skin.

**Cutis.** Skin

**Cyanosis.** Blueness of the skin, due either to heart or lung disease.

**Cyclitis.** Inflammation of the Ciliary body This is almost always associated with an iritis (irido-cyclitis), and the symptoms, etc, are similar to those of iritis (*q v*)

**Cystocele.** A dropping of the bladder in the female, causing a projection downwards of the anterior vaginal wall

**Cystoscopy.** Examination of the urinary bladder by means of an instrument passed through the urethra The instrument is fitted with a small electric lamp and reflector, so that the interior of the bladder can be directly examined

**Cystotomy.** The operation of opening the bladder

**Dacryo-cystitis.** Inflammation of the lachrymal sac, situated near the inner angle of the eye May be very intractable

**Debility.** General constitutional weakness caused by disease or malnutrition

**Defaecation.** Evacuation of the bowels

**Deglutition.** The act of swallowing

**Delirium.** Wandering of the mind in unconscious states

**Delirium tremens.** Delirium associated with hallucinations and violent trembling of the limbs due to alcoholic poisoning

**Delusion.** A fixed erroneous idea demonstrably false to a normal mind.

**Dementia.** Insanity

**Dermoid cyst.** A peculiar form of cyst in which may be found abnormal

structures such as hair, or even teeth and bony tissue. They are probably derived from embryonic cells.

**Desquamation.** Separation of the superficial layers of the skin, occurring in eczematous conditions. The peeling following scarlet fever is technically called Desquamation.

**Diagnosis.** The identification of a disease or abnormality.

**Diaphragmatic Hernia.** A protrusion of a viscus through the diaphragm usually due to congenital weakness of this muscle, but may be due to a wound of the diaphragm or precipitated by a sudden strain.

**Diaphysis.** The shaft of a long bone.

**Diarrhoea.** Frequent liquid evacuations of the bowel.

**Diathesis.** A tendency towards disease.

**Digit.** One of the toes or fingers.

**Dilatation.** Stretching of the walls of a hollow organ.

**Diplegia.** Paralysis of two limbs.

**Diplopia.** Double vision.

**Dipsomania.** Uncontrollable desire for alcohol.

**Diuresis.** Passage of large quantities of urine.

**Diverticulum.** A pouch-like protrusion from a hollow organ.

**Dorsal.** Pertaining to the back.

**Dorsum.** The back. The dorsum of the foot is its upper surface.

**Dropsy.** Collection of fluid in the connective tissue, due commonly to heart or kidney disease. In the former it is chiefly confined to the extremities, and in the latter may be general.

**Duct.** A narrow tube for the passage of the secretion of a gland.

**Dysmenorrhoea.** Painful menstrual flow.

**Dyspepsia.** Indigestion. May be due to abnormality in the function of the stomach, inappropriate or infected food, or to organic changes in any part of the alimentary canal.

**Dysphagia.** Difficulty in swallowing.

**Dyspnoea.** Difficulty in or excessive rapidity of breathing.

**Ecchymosis.** Dilation of superficial blood vessels, sometimes associated with exudation of blood.

**Eclampsia.** A toxic condition associated with fits and albuminuria in pregnant women.

**Ectropion.** Eversion of the eyelids. May be due to malformation or to injury.

**Efferent Nerve Impulse.** An impulse starting from the brain passing towards the end of the nerve.

**Effusion.** Escape of fluid from its normal containing vessel, e.g. from the blood-vessels or lymph-vessels.

**Elephantiasis.** An abnormal growth of the skin and subcutaneous tissues. It is a tropical disease, and due most commonly to infection by an organism.

**Embolus.** A clot of blood causing blocking of an artery. Such a clot is usually formed in a vein, where it is called a Thrombus, and becoming separated travels round the circulation until it blocks a small artery, when it is termed an embolus.

**Emesis.** Vomiting.

**Emphysema.** (1) Of the lungs. A condition of distension of the small air sacs common in elderly people. Causing shortness of breath. Commonly associated with bronchitis. (2) Of the tissues. Escape of air or gas into the connective tissues. Commonly met with in wounds of the chest wall (*qv*).

**Encephalitis.** Inflammation of the brain.

**Endarteritis.** Inflammation of the lining of the arteries, commonly due to syphilis.

**Endemic.** An endemic disease is any disease which is liable to occur

without any apparent cause, and which shows a tendency to occur in special localities

**Endometritis.** Inflammation of the lining of the womb

**Endosteal.** Situated within a bone

**Engorgement.** Distension with fluid

**Enterocolitis.** Inflammatory conditions of the large and small bowels combined

**Entropion.** Inversion of the eyelids Caused by malformation or injury

**Enuresis.** Involuntary passage of urine

**Epidemic.** An epidemic disease is one which occurs in cycles, affecting large numbers of the population at the same time

**Epidermis.** Superficial layers of the skin

**Epigastric.** The region of the abdomen lying over the stomach, i.e. in the angle between the lower margin of the ribs

**Epithelium.** The covering layers of the skin or mucous membranes

**Epulis.** A tumour growing from the gums May be fibrous or cancerous Frequently due to septic teeth

**Erosion.** Wearing away

**Eructation.** A passage of air or small quantities of gastric secretion from the stomach up the oesophagus

**Erythema.** Local redness of the skin

**Eversion.** Turning outwards

**Evanthem.** Any infectious fever

**Excision.** Cutting out

**Excoriation.** A scratch

**Exerescence.** An outgrowth

**Excreta.** Waste material passed out of the body

**Erophthalmos.** Protrusion of the eyeballs

**Expectoration.** Saliva or secretion from the lungs ejected from the mouth

**Extensor.** Pertaining to extension of a joint, or to the muscles used for this purpose

**Extravasation.** Escape of fluid from blood-vessels or a hollow viscus, such as the bladder, owing to damage to the wall of these

**Faecal Fistula.** A narrow opening connecting the bowel with the skin, through which faecal material may pass May result from inflammation or injury of the bowel

**Faeces.** Waste products contained in the large bowel

**Fascia.** Fibrous sheet, forming a sheath for the muscles and separating these from each other and the subcutaneous tissues

**Fatty Degeneration of the Heart.** A degeneration of the heart muscle associated with a deposit of fat in the muscle fibres

**Fauces.** The dividing arch between the mouth and pharynx

**Febrile condition.** The condition of fever

**Fibrinous.** Containing fibrin (A form of coagulated albumin)

**Fibro-adenoma.** An innocent growth formed of a mixture of fibrous and glandular tissue

**Fibrosis.** Conversion into fibrous tissue

**Fissure.** A crack, usually either of the skin or mucous membrane, but may be applied to any organ of the body

**Follicle.** A minute excretory gland or part of a gland A hair follicle is a depression in the skin from which the hair grows

**Fontanelle.** Spaces present at birth between the bones of the skull They should be closed by the end of the second year The ordinary position for these is in front and at the back of the top of the head

**Foramen.** A hole through a bone for the passage of nerves or blood-vessels

**Foreign Body.** Any particle of matter lodged in the tissues causing irritation

**Fulcrum.** The pivot on which a lever works

**Function.** Use

**Fundus.** The extreme end of an organ

**Galloping Consumption.** An acute form of phthisis, which rapidly spreads to all parts of the lungs, terminating fatally within a few weeks

**Gastralgia.** Pain in the stomach

**Gastric.** Pertaining to the stomach

**Gastro-enterostomy.** An artificial opening made by operation between the stomach and small bowel, necessitated by obstruction at the pyloric end of the stomach, or ulceration in the neighbourhood. The operation usually results in six months disability for hard work

**Gastrostomy.** An opening made into the stomach through the anterior abdominal wall, in cases of obstruction of the oesophagus, so as to enable the patient to be fed

**Genu.** The knee

**Gigantism.** A general overgrowth of the skeleton, resulting in excessive height of the individual, due in most cases to abnormalities of the pituitary gland

**Gleet.** Chronic urethral discharge following acute attack of gonorrhoea

**Glottis.** The upper opening of the larynx

**Gluteal.** Pertaining to the buttocks

**Glycosuria.** Sugar in the urine (See *Diabetes*)

**Grand Mal.** A term sometimes applied to ordinary epileptic fits

**Granular Kidney.** A kidney suffering from chronic disease resulting in fibrosis, usually associated with albuminuria (See *Chronic Bright's Disease*)

**Gravel, Renal.** This term is sometimes applied to a passage of small particles consisting of crystals of urates or other of the normal constituents of the urine. The condition is frequently associated with colic, and may be a precursor of a calculus

**Gumma.** A mass of chronic inflammatory tissue typical of syphilis (*g v*) in its tertiary stage

**Haemarthrosis.** Effusion of blood into a joint

**Haematemesis.** Vomiting of blood

**Haematocoele.** Effusion of blood round the testicle

**Haemoglobinuria.** The passage of blood pigment in the urine, met with in some of the acute specific fevers

**Haemopericardium.** Effusion of blood into the pericardium

**Haemoptysis.** Coughing up of blood

**Haemothorax.** Effusion of blood in the pleural cavity

**Hallucination.** Mental deception usually associated with the sense of sight or hearing

**Hammer-toe.** A deformity of the toe with flexion of the first or second interphalangeal joints. Usually caused by improperly-fitting boots or by deformity of other toes

**Heberden's Nodes.** Small swellings found in the neighbourhood of the small joints of the fingers in rheumatic patients

**Hemi-.** A prefix, meaning half

**Hemianopia.** Loss of half of the field of vision, in each eye. Due usually to intracranial trouble

**Hepatic.** Pertaining to the liver

**Hepatitis.** Inflammation of the liver

**Hour-glass Stomach.** A malformation of the stomach due to constriction at or near its centre. Usually due to contraction of a scar following ulceration

**Hydatid Cyst.** A cyst formed by a parasite called the *Echinococcus* May occur anywhere in the body, most commonly in the liver

**Hydrarthrosis.** Effusion of clear fluid into a joint (See *Synovitis*)

**Hydrocephalus.** Distension of the brain cavities by excessive formation of cerebro-spinal fluid, causing enlargement of the whole head It is an abnormality of infancy and patients do not, as a rule, live to maturity

**Hydropericardium.** Effusion of clear fluid into the pericardium Usually associated with pericarditis

**Hydropneumothorax.** A mixture of clear fluid and air in the pleural cavity

**Hydrothorax.** Effusion of fluid into the pleural cavity

**Hymen.** A fold of mucous membrane partly or completely obstructing the vaginal canal, found normally in unmarried women

**Hyperaemia.** Local dilatation of blood-vessels causing excessive flow of blood to the part

**Hyperaesthesia.** Excessive sensitiveness to touch or pain

**Hyperchlorhydria.** Excessive acidity of the gastric juice

**Hyperplasia.** Local overgrowth of tissue

**Hyperpyrexia.** Excessive increase in the temperature of the body Any temperature over 105 degrees may be so termed

**Hyperthyroidism.** Excessive secretion of the thyroid gland (See *Graves' Disease*)

**Hypertrophy.** Overgrowth of any part of the body

**Hypochondriac Region.** The region of the abdomen lying immediately below the lower margin of the ribs

**Hypochondriasis.** Neurotic condition associated with introspection and general exaggeration of ill-health.

**Hypogastrium.** Region of the abdomen lying in the middle line between the umbilicus and pubes

**Hypopyon.** Pus in the anterior chamber of the eye

**Hypostatic Congestion of the Lungs.** Congestion of the lungs occurring in patients who are confined to bed for long periods, especially if of advancing years It is a common cause of death in elderly patients who are confined to bed

**Hysteria.** A condition of emotion, associated with loss of control, during which the patient may have extravagant ideas and generally lose control of the nervous system Under such circumstances imaginary symptoms of all kinds may be present Appropriate treatment will usually result in a rapid cure

**Ichthyosis.** Skin disease characterized by patches of thickening of the skin and scalliness, which is very intractable

**Icterus.** Jaundice

**Idiosyncrasy.** A natural susceptibility of individuals to certain diseases or abnormalities

**Idiopathic.** Arising spontaneously and with no apparent cause

**Ileo-colitis.** Inflammation of the lower part of the small intestine and of the large bowel

**Ileus.** Dilatation of the intestines, found in a late stage of general peritonitis

**Iliac.** Pertaining to the ilium

**Illusion.** A false sensory image or a false interpretation of a sensory stimulus

**Impermeable Stricture.** A stricture of the urethra so tight as to prevent the passage of any instrument Such a stricture almost invariably needs operation

**Incision.** A wound made by a sharp instrument

**Incontinence of Urine.** Inability to hold the water

**Incubation.** When applied to fevers the term is used to express the time



that elapses between the date of infection and the date of manifestation of the first symptoms of the disease

**Indolent Ulceration.** Slow, chronic form of ulceration in which there is very little tendency to healing

**Induration.** Thickening and hardening of the tissues, due usually to chronic inflammation, resulting in fibrous tissue formation

**Infarction.** The formation of an infarct, this is an area of tissue undergoing degeneration as the result of the blocking of its artery of supply by an embolus

**Inferior.** Lower As opposed to superior

**Inguinal.** Pertaining to the groin

**Inoculation.** The artificial production of a mild form of any infective disease, by the injection of the corresponding organism or its poison Strictly speaking, the term is applied to the entry of organisms at any time into the body, but it is most commonly used to describe the intentional injection employed as a protective measure against any infective disease

**Inorganic.** Non-living

**Insomnia.** Sleeplessness

**Insulin.** Material prepared from the sweetbread of animals, used as a cure for diabetes

**Integument.** Covering, skin

**Intention Tremor.** A trembling of the hands or limbs, occurring only when an attempt is made to use them It is a characteristic sign of the nervous disease, disseminated sclerosis

**Intercostal.** Pertaining to the space between contiguous ribs

**Interosseous.** The space or structures lying between bones

**Interstitial.** Applied to the spaces between the cells of any organ

**Interstitial Keratitis.** Inflammation of the cornea owing to disease, commonly syphilis

**Intracapsular Fracture.** A fracture of a long bone lying within the capsule of a joint

**Intubation.** In cases of obstruction in any of the tubes or passages of the body, it is sometimes necessary to pass a metal or rubber tube through the obstruction in order to establish a clear passage Such an operation is called "Intubation" The term is most commonly applied to the operation performed for this purpose on the larynx, which has become obstructed in cases of diphtheria

**Intussusception.** The inversion of one portion of bowel into the opening of the bowel beyond, e.g. similar to the turning inside out of the finger of a glove It is rarely met with in adults, but is not uncommon in children It gives rise to acute intestinal obstruction

**Ischaemia.** Local defective circulation It is commonly applied to the interference in the circulation caused by tight bandaging or splinting, and may give rise to protracted paralysis and contraction of the muscles

**Ischaemic Contraction.** Contraction of muscles caused by ischaemia, resulting in deformity

**Ischio-rectal Abscess.** An abscess at the side of the anal canal May be due to tubercle May give rise to an intractable sinus or fistula

**Keloid.** A peculiar form of scarring, in which the scar tissue is formed in excessive amount (See *Cheloid*)

**Keratosis.** A skin disease associated with the formation of horny out-growths or callosities

**Labium.** Literally "lip" It is a term applied to folds of skin or mucous membrane surrounding orifices in various parts of the body, most commonly used to describe the folds of skin present at the vaginal orifice

**Lachrymation.** Formation of tears A common symptom of most eye complaints

**Lactation.** The formation of milk during and following pregnancy

**Lamina.** A flat plate of bone, most commonly used to describe the flat bony plate forming the arch at the back of each vertebra beneath which lies the spinal cord

**Laminectomy.** Operation for the removal of the laminae of the vertebrae to expose the spinal cord

**Laparotomy.** An exploratory operation through the abdominal wall

**Laryngotomy.** An opening made through the neck into the larynx for the purpose of removing small growths

**Lateral.** Pertaining to the side

**Leuchaemia.** A form of blood disease in which there is an excessive number of white blood corpuscles

**Leucocytosis.** The formation of large numbers of white blood corpuscles It occurs as a natural result of acute inflammation

**Leucoderma.** A skin disease associated with the development of white patches on the skin

**Leukokeratosis, or Leukoplakia.** The development of white patches on the mucous membranes or skin associated with thickening of the superficial layers Commonly due to syphilis

**Lichen.** Skin disease associated with multiple small patches of thickening of the superficial layers of the skin

**Ligature.** The tying of a blood vessel to stop haemorrhage The word is also used to describe the material used for the purpose, e.g. catgut, silk

**Lingual.** Pertaining to the tongue

**Lithotomy.** The operation of opening the bladder for the removal of a stone

**Lithotripsy.** The operation of crushing a stone in the bladder by passing an instrument through the urethra

**Ludwig's Angina.** An acute inflammation in the neighbourhood of the sub-maxillary gland Usually associated with the formation of pus and extensive swelling of the soft tissues of the neck

**Lues.** Syphilis

**Lumbar.** The lumbar region is that part of the back lying between the ribs and the ilium and sacrum The loin

**Lumbricals.** Small muscles in the hand, whose action is to assist in flexing the metacarpo-phalangeal joints and extending the first interphalangeal joints

**Luxation.** A partial dislocation or slipping of two articular surfaces upon each other

**Lymphangiectasis.** Dilation of the lymphatic vessels

**Lymphangioma.** A tumour formed of an overgrowth of lymphatic vessels

**Lymphangitis.** Inflammation of the lymphatic vessels Commonly follows septic wound owing to the passage of organisms along the vessels

**Lymphatic State.** (See *Status Lymphaticus*)

**Lympho-sarcoma.** A malignant growth composed of tissue arising in and resembling lymphatic glands

**Macrodactyly.** Congenital enlargement of the fingers or toes The enlargement is usually due to the fusion of two or more toes together (or fingers)

**Macroglossia.** An enlargement of the tongue It may be congenital or due to chronic inflammation

**Main en Griffe.** Claw hand A deformed condition of the fingers which resemble claws, being over-extended at the metacarpo-phalangeal joints and flexed at the interphalangeal joints It is due to nerve injury in the forearm the median and ulnar nerves being involved

**Malleolus.** The prominence of bone on each side of the ankle Formed by the lower end of the tibia on the inner side and the fibula on the outer side

**Mammæ.** The breasts

**Mandible.** The jaw

**Mania.** Acute mental disorder, frequently associated with homicidal or suicidal tendencies. It may be a complication of pregnancy or acute septic infections

**Meatus.** External orifice of a duct, e.g. the urethral orifice, external auditory orifice

**Meckel's Diverticulum.** A blind pouch of intestine which is sometimes found attached to the lower part of the small bowel, and may give rise to symptoms of inflammation or intestinal obstruction

**Median.** Towards the middle line

**Mediastinum.** The space between the two lungs in the thorax

**Medulla.** Marrow. The medulla oblongata is a portion of the brain connecting the main hemispheres with the spinal cord

**Meibomian Cysts.** Small cysts found on the eyelids due to blocking of the glands of the skin

**Melaena.** Black motions. May be due to taking of certain drugs, e.g. bismuth or iron, or to haemorrhage high up in the alimentary canal

**Melanotic.** A melanotic sarcoma is one containing black pigment. It usually arises from a patch of pigmented skin

**Membranous Laryngitis.** A form of laryngitis associated with the formation of a membrane, which may block the airway. Usually due to diphtheria organism

**Meningocele.** A protrusion of the membranes of the brain containing fluid. It may occur in any position where there is a normal suture between the skull bones. It frequently occurs also as a protrusion of the coverings of the spinal cord at the lower end of the spine. It may follow severe bony injury to the skull, but is usually congenital

**Menopause.** The cessation of the monthly flow in women which normally occurs between the ages of 40 and 50. It is frequently associated with peculiar symptoms of nervousness, and may cause the effects of accidents to be much more serious than normal, neurasthenia being a common sequela of accidents to women of this age

**Menstruation.** The monthly flow in women

**Metastatic Abscess.** An abscess which develops in a part of the body remote from the original source of infection, but due to this, e.g. in pyaemia (*qv*)

**Meteorism.** Distension of the intestines, due to an accumulation of gas. The bowel is usually paralysed. It is a serious complication of general peritonitis

**Metritis.** Inflammation of the womb

**Micrococcus.** A generic name given to minute round organisms, e.g. staphylococci, streptococci, etc

**Micro-organisms.** A generic term applied to all bacterial forms of life

**Micturition.** The act of passing water

**Miliary Tubercle.** A common form of tubercle of the lungs, pleurae or peritoneum, in which minute foci of infection appear as multiple scattered nodules, in the infected part

**Miscarriage.** The expulsion from the uterus of the products of conception within the first two or three months of pregnancy

**Mitral.** The mitral valve is the valve on the left side of the heart, separating the left auricle from the left ventricle

**Mitral Stenosis.** Narrowing of the mitral valve owing to formation of fibrous tissue as the result of valvular disease of the heart

**Monoplegia.** Paralysis of one limb

**Morbus.** Disease

**Mortification.** Local death of a part

**Mucocele.** A cavity distended with mucus

**Mucus.** A secretion of the membranes lining the viscera and cavities of the body communicating with the exterior, e.g. mouth, nose, etc

**Murmur (Cardiac)** Abnormal heart sounds (See *Bruit*)

**Myeloid Sarcoma.** A sarcoma developing in the marrow of the long bones, usually near an extremity of the bone. Some forms of this growth are very slow growing and may be successfully removed locally

**Myocarditis.** Inflammation of the heart muscle. May be due to rheumatism, influenza, or other specific disease

**Myocardium.** Heart muscle

**Myo-fibroma.** A tumour formed by fibrous and muscular tissue, commonly found in the uterus

**Myositis.** Inflammation of muscle. May be due to rheumatism, gonorrhoea, or septic infection

**Myxoma.** A tumour formed of cells secreting mucus

**Myxo-sarcoma.** A malignant form of myxoma

**Naevus-lipoma.** A tumour formed of a mixture of fatty tissue and blood-vessels. Innocent

**Naevus.** A tumour formed of dilated blood-vessels. A birth-mark is a simple form of this

**Narcosis.** The administration of anaesthetics

**Nausea.** Feeling of sickness

**Nebula.** Literally a cloud. A term usually applied to the film formed in the cornea as a result of scarring or disease

**Necropsy.** A post-mortem examination

**Necrosis.** Slow destruction of bone by disease (See *Diseases of Bone*)

**Nephrectomy.** Removal of a kidney

**Nephro-lithuasis.** Stone in the kidney

**Nephro-lithotomy.** Removal of a stone from the kidney

**Nephropexy.** The operation of fixation of the kidney performed for the dropping of this organ

**Nephrotomy.** An exploratory operation on the kidney

**Nits.** Small parasites present in the hair in uncleanly individuals. May give rise to skin troubles of the scalp and enlargement of glands of the neck

**Nodes.** Small swellings, usually consisting of fibrous tissue, which may develop in any part of the body. The term is also applied to local thickening of bone

**Occipital.** Pertaining to the back of the head or occiput

**Occiput.** The region of the head in the neighbourhood of the occipital bone

**Odontome.** A swelling in the jaw caused by a tumour derived from the teeth

**Oedema.** The escape of fluid from the lymphatic vessels or blood-vessels into the surrounding tissues, causing general swelling of the part. It may be due to inflammation, obstruction of the vessels, kidney disease, or heart disease

**Oedematous.** The term applied to describe the condition of oedema

**Olfactory.** Pertaining to the sense of smell

**Omentum.** A reduplicated fold of peritoneum hanging like a curtain in front of the intestines

**Onychia.** An infective condition of the nails, associated with a generally debilitated state of the patient. The skin round the base of the nails becomes septic and the condition is likely to spread until all the nails become inflamed. It is sometimes associated with syphilis

**Oophoritis.** Inflammation of the ovaries

**Opacity.** An obstruction to the passage of light through the eye. May be due to scarring of the cornea or lens, or to the remains of inflammatory products in the vitreous humor (floating vitreous opacities)

**Ophthalmia.** Inflammation of the eye  
**Ophthalmic.** Pertaining to the eye  
**Ophthalmoplegia.** Paralysis of the eye muscles  
**Ophthalmoscope.** The instrument used for examining the interior of the eye  
**Oral Sepsis.** Strictly speaking, any septic infection of the mouth Usually applied to septic condition of the gums  
**Orbit.** The bony cavity in which the eye is situated  
**Organic.** Pertaining to living matter  
**Osteitis Deformans.** A rare disease of the skeleton, associated with bending of the bones and considerable deformity Cause unknown Duration indefinite  
**Osteoclasia.** Crushing of bone  
**Osteomalacia.** A rare disease of bones, probably due to defect in nutrition, in which the bones become softened and thinned  
**Osteophytes.** Small bony outgrowths in the neighbourhood of joints which develop in cases of chronic arthritis  
**Osteo-sarcoma.** A sarcoma (cancer) developing from bone  
**Osteotomy.** The breaking of a bone by a surgeon, usually to correct a deformity  
**Ovarian Cysts.** Cysts which may develop to a very large size, derived from the ovary.

**Palpebral.** Pertaining to the eyelids  
**Palpitation of the Heart.** Irregular action of the heart, felt consciously May be due to heart disease, but is frequently due merely to some temporary embarrassment of the heart's action Excessive smoking is a common cause  
**Palsy.** Paralysis  
**Panophthalmitis.** Inflammation of the whole of the eyeball, due to injury or other cause of septic infection  
**Papillitis.** A term usually applied to inflammation of the optic nerve, where it enters the eyeball  
**Papilloma.** A small innocent tumour formed on the skin, or any part of the body covered with stratified epithelium, i.e. epithelium similar to that found on the skin A wart is a common form of this  
**Paracentesis Abdominis.** Exploration of the abdominal cavity with a hollow needle  
**Paralysis.** Partial or complete loss of muscular power  
**Paralysis Agitans.** A nervous disease characterized by peculiar shaking of the hands and fingers It occurs only in old age and is incurable Cause unknown  
**Paraphimosis.** Retraction of the foreskin behind the glans penis sometimes results, if the foreskin is tight, in inability to return the foreskin to its normal position This is followed by oedema and inflammation of the foreskin and glans  
**Para-typhoid Infection.** Infections due to bacilli of the typhoid group but not belonging to the true typhoid species The symptoms are similar to those of typhoid  
**Paresis.** Paralysis It is a term usually applied to cases of partial paralysis  
**Parietal.** Pertaining to the wall of a cavity, e.g. parietal pleura and peritoneum which are those parts of these membranes lining the walls of the thorax and abdominal cavity respectively, as opposed to the visceral pleura and peritoneum which cover the viscera contained within these cavities The parietal bone is a bone of the skull covering its side and top  
**Parietes.** The walls of the thorax or abdomen  
**Parieto-occipital Region.** The region of the skull corresponding to the parietal and occipital bones

**Paronychia.** A septic infection of the skin surrounding the nails Very similar to onychia

**Paroxysm.** A sudden onset or aggravation of symptoms Commonly used in connection with severe pain or fits

**Parturition.** The act of child-birth

**Pediculi Capitis.** A parasite present on the scalp and hair, popularly known as "Nits" (*qv*)

**Penis.** The external genital organ of a male

**Perichondritis.** Inflammation of the covering of cartilages Similar to periostitis

**Perihepatitis.** Inflammation of the peritoneum covering the liver

**Perinephritis.** Inflammation of the tissues surrounding the kidney The cause is usually due to infection spreading from the bowel

**Perineum.** The area bounded by the tip of the coccyx behind and the pubic arch in front

**Periosteal Sarcoma.** Cancer growing from the periosteum It is a very malignant form of growth

**Periosteum.** Fibrous covering of bones

**Peripheral.** Pertaining to the extremities or surface of the body, as opposed to the central parts

**Peritoneum.** Thin membrane lining the abdominal cavity and covering the intestines That covering the abdominal wall is called parietal peritoneum, whereas that enclosing the viscera and intestines is the visceral peritoneum

**Pes Calcanens.** A deformity of the foot in which the heel points downwards instead of backwards

**Petechiae.** Small area of dilated blood-vessels

**Petit Mal.** A form of epilepsy (*qv*)

**Phagedena.** A gangrenous form of inflammation

**Phagocytosis.** (See *Leucocytosis*)

**Phimosis.** Narrowing of the orifice of the foreskin

**Phlebitis.** Inflammation of veins Frequently a complication of varicose veins, or may be due to injury or follow general septic infections

**Photophobia.** Intolerance of the eye to light A common symptom in all eye diseases

**Pityriasis.** A skin disease characterized by the formation of bran-like scales

**Plantar.** Pertaining to the sole of the foot

**Plethora.** Engorgement

**Pneumococcus.** A diplococcus causing pneumonia

**Polyuria.** The passage of excessive quantities of urine

**Posterior.** Pertaining to the back, as opposed to anterior

**Post-mortem.** Literally "after death" Used as an abbreviation for post-mortem examination

**Post-pharyngeal.** The parts behind the pharynx

**Prepuce.** Foreskin

**Proctitis.** Inflammation of the rectum

**Prognosis.** Expression of opinion as to the future course of a disease

**Prolapse.** The dropping of an organ through an external orifice, e.g. prolapse of haemorrhoids through the anus, prolapse of uterus into the vagina

**Prophylactic.** Preventative It is a term applied to measures adopted to prevent disease

**Protein.** Albuminous substances of which protoplasm is formed

**Prurigo.** Irritation of the skin or mucous membranes

**Pruritus.** (See *Prurigo*)

**Pseudarthrosis.** A false joint Sometimes formed at the site of a fracture, if the fragments have not united

**Pseudo-angina.** A false form of angina, in which the patient suffers from acute pain in the region of the heart. The cause is unknown, but the cases are less severe and more tractable than those of true angina.

**Ptosis of the Eyelid.** A condition of dropping of the eyelid over the eyeball, caused usually by paralysis of the third cranial nerve.

**Ptyalism.** Excessive salivation. It is a symptom of mercury poisoning, and may be neurotic in origin.

**Puberty.** The age when the sexual organs reach maturity, and when secondary sexual characteristics, e.g. in males the breaking of the voice and growth of hair on the face, make their appearance. In temperate climates this occurs at about 12 to 15 years of age. In tropical climates the age may be very much younger.

**Pubic.** Pertaining to the pubes.

**Puerperal Fever.** A fever due to septic infection in the uterus, arising at or immediately after childbirth.

**Pulled Elbow.** An injury to the elbow due to a wrench, in which the head of the radius may be partially displaced and in which the synovial membrane and ligaments are usually damaged. Disability may last for six or eight weeks.

**Pulmonalis.** Pertaining to the lungs.

**Pulmonary.** Pertaining to the lungs.

**Purpura.** A discoloration of the skin due to a rash, which is frequently caused by blood poisoning.

**Purulent.** Associated with the formation of pus.

**Pustule.** Small septic spot containing pus.

**Pyelonephritis.** Inflammation of the kidney and its pelvis.

**Pylephlebitis.** Inflammation of the veins of the liver.

**Pylorectomy.** Excision of the pylorus. The operation is performed for obstruction of the pylorus due to ulceration or growth.

**Pyloroplasty.** An operation for widening the pyloric opening of the stomach. Necessitated in some cases of obstruction due to scarring of an old ulcer.

**Pyloric Stenosis.** Obstruction of the pylorus.

**Pyogenic.** Pus forming, e.g. pyogenic organisms are those causing the formation of pus.

**Pyonephrosis.** Abscess of the kidney.

**Pyopneumothorax.** A pneumothorax (*qv*) in which pus has also formed.

**Pyo-salpinx.** An abscess of the Fallopian tubes.

**Pyorrhoea Alveolaris.** A condition of septic infection of the gums which may result in chronic ill-health owing to absorption of poisons. It also causes gastric disturbance owing to the swallowing of the pus. Treatment consists of the removal of the teeth. In early stages local treatment of the gums and the injection of vaccines may be successful.

**Pyrexia.** Increase of the temperature of the body.

**Pyuria.** Pus in the urine.

**Quartan Ague.** Form of malaria (*qv*).

**Quotidian Ague.** Form of malaria (*qv*).

**Ramify.** To spread by branching.

**Ramus.** A branch. A term applied in anatomy to a process of bone projecting from the main body of the bone.

**Ranula.** A cystic swelling in the front of the mouth. Caused by distension of a mucous gland.

**Reaction of Degeneration.** An alteration in the electrical reactions of a muscle which is paralysed owing to nerve injury. When such a reaction is present, there is very little, if any, hope of the muscle regaining its power.

**Reduction.** When applied to a dislocation, it means the return of the bony parts of the joint to their normal position. It is also used in describing the

result of an examination of the urine. In this case the term is used to describe the reaction showing the presence of sugar in the urine.

**Regurgitation.** A flowing back. It is applied to describe the flowing back in an abnormal direction of the contents of a hollow viscus, e.g. regurgitation of food from the stomach into the mouth. Regurgitation of blood from the ventricles to the auricles of the heart may occur in valvular disease.

**Renal Colic.** Acute pain in the loin. May be due to a stone in the kidney or ureter, but sometimes occurs for no apparent reason.

**Resection.** Removal by operation, usually of only part of an organ.

**Resolution.** A term applied to the changes that take place in the lungs when a patient is recovering from pneumonia, and the lungs become air-containing again, instead of being solid.

**Retained Testis.** An abnormality in which the testicle is retained in the abdominal cavity, instead of descending as it should, into the scrotum.

**Retention of Urine.** Inability to pass urine from the bladder, owing to obstruction, at the neck of the bladder or in the urethra.

**Retro-peritoneal.** Lying behind the peritoneum.

**Rider's Bone.** An overgrowth of bone on the inner side of the lower end of the femur, at the insertion of the adductor muscles, the tendon of which frequently becomes ossified. It has been given this name as it is frequently caused by pressure on the inner side of the knee, e.g. in riding.

**Rigor Mortis.** Stiffening of the tissues following death. It usually occurs under normal conditions within twelve hours after death. The condition may be delayed.

**Rigors.** Shivering fits, associated with a sudden drop in the temperature of the body from a high point, e.g. 104 or 105 degrees, to normal or below, followed by a subsequent rise again. It is a sign of very severe fever.

**Round Worms.** Parasites found in the large bowel.

**Salivary Calculus.** A calculus formed in the salivary glands or their ducts.

**Salivation.** The formation of saliva.

**Salpingitis.** Inflammation of the Fallopian tubes. Frequently due to gonorrhoea.

**Salvarsan.** A preparation of arsenic used for injection as a cure for syphilis.

**Saphenous Vein.** The main vein of the leg running from the groin beneath the skin down the inner side of the thigh. It is the vein most commonly affected in varicose veins.

**Sapraemia.** A form of toxæmia due to absorption of poisons from decomposing tissues.

**Saturnism.** A name sometimes given to lead poisoning.

**Scarlatina.** A mild form of scarlet fever.

**Scurrhus.** A form of cancer of the breast, associated with the formation of a large amount of fibrous tissue. It is comparatively slow growing.

**Scleritis.** Inflammation of the sclerotic membrane of the eye.

**Scleroderma.** An abnormal condition of the skin characterized by thickening and dryness of the superficial layers.

**Sclerosis.** The formation of fibrous tissue. This usually is the result of chronic inflammation.

**Scorbutus.** Scurvy (qv).

**Scotoma.** A term applied to a gap in the iris, the result of abnormal development.

**Scrofula.** An old term used to describe a general tuberculous condition, associated with the enlargement of glands and the formation of sinuses.

**Scurvy.** A disease of nutrition due to lack of fresh fruit and vegetables.

**Scybala.** Hard faecal masses formed in the large bowel, as the result of chronic constipation.



**Seborrhoea.** Skin disease associated with abnormal secretion of the sebaceous glands

**Sedentary.** Literally, sitting down, opposed to active

**Semen.** The reproductive fluid of the male

**Semi-membranosus Bursa.** A bursa (*qv*) situated on the inner side of the knee joint and sometimes connected with it

**Senile.** Pertaining to old age

**Separation of Epiphyses.** An injury to the bones in children or young adults, in which the epiphysis is separated from the main shaft. It is sometimes followed by increasing deformity as the bone grows, owing to partial destruction of the epiphyseal cartilage where growth occurs

**Septic.** Infected by organisms

**Septico-pyæmia.** A term sometimes applied to general blood poisoning

**Septum.** A dividing partition, e.g. septum of nose

**Sequela.** A disease or abnormality following as a result of another disease

**Sequestrum.** A piece of dead bone separated from the living bone as a result of inflammation (See *Osteo-myelitis*)

**Serous.** Pertaining to the serum (*qv*)

**Sinus.** An artificial passage connecting some deep-seated inflammation with the surface of the body, through which pus is discharged. Commonly found as the result of inflammation of bone. It is also an anatomical term applied to cavities in the bones communicating with the outside, e.g. frontal and maxillary sinuses communicating with the nasal cavities

**Slough.** Slough is a portion of dead tissue, separated by a natural process of repair from the living tissue

**Somnambulism.** Sleep walking

**Spasm.** A violent involuntary muscular contraction. If it is continuous it is termed "Tonic", if intermittent, "Clonic". It is often associated with colic

**Spasmodic.** Sudden irregular movements of the limbs or viscera

**Spastic Paraplegia.** A paraplegia (*qv*) in which the paralysed limbs are stiff. It is due to disease in the upper part of the spinal cord or in the brain

**Specific Gravity.** The specific gravity of a fluid is a measure of its relative density compared with water. It is measured by comparing the buoyancy of the two, a fluid of high specific gravity being more buoyant than water. As salts in solution increase the specific gravity of a fluid, an estimation of the specific gravity is an indication of the degree of concentration of the salts in solution. The specific gravity of water is usually taken as 1000.

**Specific Infectious Diseases.** A general term applied to include all the usual infectious diseases, such as measles, scarlet fever, etc.

**Speculum.** An instrument used for examining the interior of the orifices of the body, e.g. nasal speculum, aural speculum

**Spermatic Cord, Hydrocele of.** This is a swelling containing clear fluid, occurring round the spermatic cord and sometimes associated with a rupture. It is usually congenital and not due to injury

**Spermatocele.** A cystic swelling of the testicle near the epididymis, containing spermatic fluid

**Spermatozoa.** The active reproductive cells in the seminal fluid

**Sphincter.** Circular muscle fibres forming a localized ring of muscle controlling the orifices along the alimentary canal, e.g. the pylorus, ileo-caecal orifice, anus. There is also one at the neck of the urinary bladder

**Spina Bifida.** A mal-formation of the vertebral column, in which the vertebral canal is not closed behind and allows the coverings of the spinal cord to protrude

**Splenic Anaemia.** A form of anaemia associated with enlargement of the spleen. It is a chronic condition which usually proves fatal within a few months

- Splenitis.** Inflammation of the spleen
- Spleno-medullary Leuchaemia.** A form of leuchaemia (*qv*) associated with enlargement of the spleen Duration indefinite
- Spondylitis Deformans.** A name for osteo-arthritis of the spine
- Sporadic.** A disease is said to be sporadic when it occurs in isolated places scattered in different localities
- Spotted Fever.** A term sometimes applied to cerebro-spinal meningitis
- Sputum.** The secretion of the respiratory passages other than the nose
- Staphylococci.** A form of micro-organism, found almost universally on the skin and mucous membranes It is comparatively harmless, but may give rise to mild forms of infection if it gains entry into the blood
- Stenosis.** The narrowing of a cavity or hollow passage, e.g. stenosis of the mitral valve, stenosis of the pylorus
- Stenson's Duct.** The duct of the parotid gland
- Stereoraceous.** Faecal, pertaining to the excreta
- Stereoral Ulcer.** An ulcer of the large bowel, caused by irritation due to the retention of hard faecal material
- Stertor.** Snoring
- Stertorous Breathing.** (See *Stertor*)
- Stomach, Gastro-enterostomy.** An artificial opening made between the stomach and the small bowel, to relieve obstruction near the pylorus (See *Diseases of Stomach*)
- Stomach, Gastrotomy.** An opening made into the stomach through the anterior abdominal wall in case of obstruction of the oesophagus, so as to enable the patient to be fed
- Stomach, Haemorrhage from.** May be a symptom of cancer or ulcer in the stomach It sometimes occurs without any definite organic disease of the stomach If continued may cause serious anaemia
- Stomach, Hour-glass.** A malformation of the stomach due to constriction at or near its centre Usually due to contraction of a scar following ulceration
- Stomach, Perigastric Abscess.** (See *Subphrenic Abscess*)
- Stomach, Pyloroplasty.** An operation for increasing the size of a contracted pylorus
- Stools.** Faecal material passed when the bowels are open
- Strabismus.** Squint
- Strangulation of the Bowel.** A bowel is said to be strangulated when part of it is nipped so as to cut off its blood supply This may be due to adhesions (*qv*), and may occur in a rupture (See *Strangulated Hernia*)
- Streptococci.** The organism most commonly responsible for acute septic infection It varies greatly in virulence Its effects may be chronic or may be fatal within a few days
- Stricture.** A stricture of the urethra is a narrowing of the passage as the result of inflammation or injury The cause in inflammatory cases is almost invariably gonorrhoea (*qv*)
- Strumous.** Tuberculous or tendency to tubercle
- Stye.** A cyst of the eyelid, which may suppurate and need operation It may be disabling on this account, but does not interfere with the sight
- Styptic.** A styptic material is one which has the effect of causing local clotting of blood and so stopping haemorrhage
- Subcutaneous.** The tissues lying beneath the skin
- Subdiaphragmatic Abscess.** (See *Subphrenic Abscess*)
- Subluxation.** A partial dislocation
- Subphrenic Abscess.** An abscess under the diaphragm Usually due to chronic ulceration of the stomach or to inflammation in the neighbourhood of the liver
- Superior.** Situated above Opposed to inferior

**Suppression of Urine.** Cessation of the secretion of urine due to disease of the kidney or to calculus

**Suppuration.** The formation of pus

**Suppurative Pylephlebitis.** Multiple abscesses formed in the liver owing to suppurating inflammation occurring in the neighbourhood of the portal vein and conveyed to the liver by this vein

**Suture.** (1) The line of union between the skull bones (2) Material such as catgut or silk, used for sewing up a wound

**Sycosis.** A skin disease characterized by inflammation of the hair follicles

**Synchondrosis.** The union of two bones by cartilage

**Syncope.** Fainting due to cardiac failure

**Synechia.** An adhesion between the iris and the cornea or lens

**Synostosis.** The union of two bones without the interposition of cartilage

**Syphilides.** Skin diseases due to syphilis

**Taenia Solium.** Tape worm A parasite which inhabits the large bowel It may grow to enormous length and consists of a head, provided with suckers, and a body consisting of segments, of which there may be several hundred Each one of these, if separated from the rest, may reproduce itself Symptoms are those of irritation of the bowel

**Tapeworm.** (See *Taenia Solium*)

**Temporal.** The region of the skull over the temporal bone

**Tendon.** The fibrous prolongation of a muscle by which this is inserted into the bone

**Tendon Reflexes.** If a tendon which is partly stretched is lightly tapped, contraction of the muscle follows The knee jerk (*qv*) is the best example of this Abnormalities of these reflexes are indications of nervous disease

**Tenesmus.** A painful and ineffectual desire to pass a motion

**Teno-synovitis.** Inflammation of the synovial sheaths of tendons May be caused by constant or sudden strain, or by disease Disability usually lasts three to four weeks

**Tenotomy.** The cutting of a tendon, performed for the correction of deformity

**Tertian Ague.** A form of malaria (*qv*)

**Testis.** Abnormal Position of. (See *Undescended Testis*)

**Threadworms.** Small worms found in the large bowel, causing symptoms of irritation of the anus and general ill-health The eggs are taken by the mouth from unwashed green stuff, e.g. watercress

**Thrombosis.** Clotting of blood in veins A frequent complication of varicose veins

**Thrombus.** A clot of blood formed in a blood-vessel It may become separated from the wall of the blood-vessel and circulate in the blood It is then called an embolus

**Thyroidism.** (See *Graves' Disease*)

**Tinea Circinata.** Ringworm (*qv*)

**Tinnitus Aurium.** Abnormal sounds in the ear of a buzzing character May be caused by wax, or by disease of the ear

**Toe Nail, Ingrowing.** A condition in which the nail, usually of the great toe, by its growth penetrates into the skin at the side of the nail It may follow injury if the nail-bed has been damaged It may be curable by careful cutting of the nail, but frequently the nail has to be removed permanently

**Tongue.** **Ankyloglossia.** Fixation of the tongue due to chronic ulceration followed by scarring

**Tongue, Leukokeratosis.** A condition of thickening of the epithelium covering the tongue, which appears covered with white patches (See *Glossitis*)

**Tongue, Leukoplakia.** (See *Leukokeratosis*)

**Tonic Contraction.** A condition of contraction of a muscle which persists, as opposed to clonic which is an intermittent spasmodic contraction

**Tortuous.** Twisting

**Toxaemia.** Poisoning by toxins (*qv*)

**Toxin.** Poisonous material formed by microbes

**Tracheitis.** Inflammation of the mucous membrane of the trachea  
Usually due to spread of infection from the throat

**Trachoma.** A contagious inflammation of the eyelids Sometimes resulting in deformity of the lids by scarring

**Transfusion.** Transfusion of blood is the passing of blood from one individual into another An artery of the donor is connected with a vein of the patient by means of a tube It is a method employed to try and save the life of a patient suffering from severe forms of anaemia or blood poisoning

**Transverse.** A plane at right angles to the long axis of an organ or other part of the body, e.g. a transverse fracture is a fracture straight across the bone

**Trauma.** Injury

**Traumatic.** Caused by injury

**Tremor.** Trembling of the limbs

**Trepan.** An old term meaning trephine (*qv*)

**Trephine.** The operation of the removal of a portion of the skull bones for relieving intracranial pressure or for exploring the interior of the skull

**Trichuriasis.** An intestinal disease caused by a parasite (*Trichina Spiralis*)  
Found in undercooked pork

**Trismus.** Tonic contraction of the muscles of the jaw causing inability to open the mouth It occurs typically in tetanus, but may be due to local irritation from defective teeth, etc

**Tropic Disorders.** Affections usually of the skin but sometimes of other tissues, e.g. bone, caused by defective nutrition owing to affections of the nerves supplying the parts, or to other local causes of defective circulation

**Tropical Abscess.** An abscess usually of the liver, commonly due to dysentery or malaria

**Tuberculin.** A solution of the products of the tubercle bacillus It is used as a test for tubercle in a patient, reaction being caused if an injection is made, the reaction showing itself locally at the site of the injection, and also by increase in temperature if the patient is tuberculous It is also used in order to increase the patient's powers of resistance to the tubercle bacillus

**Tunica Vaginalis.** A thin membrane derived originally from the peritoneum and forming the covering of the testicle It may be distended at times with a clear fluid (hydrocele) or blood (haematocoele)

**Tympanites.** Distension of the intestines caused by paralysis It is commonly caused by peritonitis

**Umbilicus.** The navel This is the scar formed when the cord connecting the child with the placenta in the womb is separated at birth

**Undescended Testis.** A condition in which the normal descent of the testicle into the scrotum is stopped This may occur at any point from its original position within the abdomen If it remains in the abdomen it is called a Retained Testis It may, however, come to rest in the inguinal canal or at the external abdominal ring In any of these positions it is liable to injury and an operation may be necessary to place it in its right position or to remove it

**Urates.** The salts of uric acid, normally excreted in the urine In gouty and rheumatic conditions there may be an excess of urates formed in the tissues and so give rise to symptoms of joint and muscular pains

**Urethrotomy.** An incision into the urethra for relief of stricture

**Uric Acid.** An acid formed as the result of the breaking down of certain proteins in the body. It is a normal constituent of the urine (See *Urates*)

**Urine, Extravasation of.** Escape of urine from the bladder into the tissues as a result of injury to the bladder or urethra

**Urine, Incontinence of.** Inability to hold the water in the bladder

**Urine, Retention of.** Inability to pass the water from the bladder. Causes stricture of the urethra and enlargement of the prostate are the commonest

**Urine, Suppression of.** Failure of the kidneys to excrete the urine. Causes disease of the kidney or calculus

**Vaccine.** An emulsion of the dead bodies of bacteria and their toxins. An autogenous vaccine is one prepared from the actual organisms derived from the patient. A stock vaccine is one prepared from similar but not identical organisms. Vaccines are used for the treatment of chronic septic conditions or as a preventative against infection. The effect of injection of a vaccine is to increase the power of resistance of the patient to that particular organism

**Varicella.** Chicken pox

**Variola.** Smallpox

**Varioloid.** Resembling smallpox

**Varix.** A local enlargement of a vein

**Venesection.** The opening of a vein to allow blood to escape to relieve the heart in cases of heart disease, where the heart is embarrassed owing to congestion in the circulation

**Venous.** Pertaining to the veins

**Ventricles of Brain.** Cavities within the brain containing cerebro-spinal fluid, communicating with the central canal of the spinal cord

**Verrucae.** Warts

**Vertebral.** Pertaining to the vertebrae

**Vertigo.** Giddiness. Frequently due to arterial degeneration or weakness of the circulatory system. It frequently follows head injuries and in elderly people may be a permanent effect of these

**Vesical.** Pertaining to the bladder

**Vesicle.** A very small cyst or bleb containing clear fluid

**Vesicular.** Bladder-like

**Vestibular Nerve.** A branch of the auditory nerve supplying the internal ear

**Villous Growths.** Growths formed of minute finger-like processes. They may be innocent or malignant

**Virus.** Poison

**Viscus.** A term applied as a general name for any of the organs in the abdomen, or chest

**Volvulus.** Twisting of the intestine. May be a cause of intestinal obstruction

**Warts.** Small outgrowths from the skin. Usually multiple, and commonly situated on the hands. They are inclined to spread, and are sometimes very intractable and disabling. Electrical treatment is the best means of cure. Cause is unknown, but special forms in adults may be due to syphilis

**Wassermann Test.** A test applied to the blood which, if a positive reaction is obtained, indicates that the patient is or has been suffering from syphilis

**Wheal.** A raised oedematous swelling of the skin, caused usually by a blow

**Whitlow.** An infection of the skin and the nail-bed at the side of the nail. An abscess may be formed and infection may spread up the finger. It may be caused by the entry of a foreign body into the quick of the nail, or may arise spontaneously in debilitated patients

**Worms.** Parasites found in the large intestine Common forms are the tape-worm, round-worms, and thread-worms

**Xerodermia.** A condition of the skin associated with excessive dryness

**Zymotic.** Literally a fermentation It is a term applied to any disease caused by the growth of organisms



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